RADIOLOGY

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EDITOR

Howard P. Doub, M.D.
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Vol. 63 JULY, 1954 No. 1

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Henry Ford Hospital, Detroit 2, Mich.

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RADIOLOGY

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Vol. 63 JULY 1954 No. 1

The Effect of Roentgen Rays on Lepromatous Leprosy[1]

EUGENE F. LUTTERBECK, M.D.,[2] IRVIN F. HUMMON, M.D.,[3] ROLLA R. WOLCOTT, M.D.,[4] and FREDERICK A. JOHANSEN, M.D.[5]

VARIOUS ATTEMPTS have been made in the past to treat certain manifestations of leprosy with ionizing rays. Superficial roentgen irradiation has been employed for the local treatment of skin lesions and for the eye. Deep roentgen therapy was given in cases of neuritis. Radium has been used for the local treatment of nodules of the skin and nasal and oral cavities.

HISTORICAL

Some reference to radiation therapy in leprosy has been made in various textbooks on tropical diseases. A comprehensive survey was given by Klingmueller in 1930 in his chapter on local treatment of the disease, but unfortunately he omitted from his bibliography all titles of published papers. Strong, in Stitt's textbook, stated that cutaneous lesions, nodular infiltrations, and ulcers often respond favorably to roentgen rays, and that radium may be employed for lesions about the eyes as well as in the mouth. As opposed to this, Rogers and Muir wrote in 1946 that x-rays had their vogue but were of little benefit and were apt to cause blisters and ulcerations in nerve cases.

A. Roentgen Radiation for Superficial Lesions: According to Belot, it was Sequeira who first reported on the use of roentgen rays in leprosy in 1901, when he described partial regression of nodes and softening in a case of nodular leprosy. Oudin treated two cases in 1903, produced a good reaction with roentgen rays, and also observed regression of lesions of the face and hands. Lie, the famous Norwegian leprologist, stated in 1904 that roentgen rays have a certain influence on leprosy. He noted marked diminution of nodes after irradiation. During the same year, Pernet, of Britain, said that he had observed good local results with the rays, adding that they were, of course, not curative, the disease being a general infection, but by this means improvement of the face could be obtained in advanced cases. At the Lepra Conference in Bergen in 1909, Pernet again emphasized that x-rays cause regression and/or disappearance of the local nodules, though to talk of x-rays as curing leprosy, as was done in some quarters, he designated as "to say the least, curious."

Wilkinson published an interesting report on leprosy in the Philippines, with an

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[1] Read by title at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13–18, 1953.

[2] Attending Radiologist, Radiation Center, Cook County Hospital, Chicago, Ill.

[3] Director, Radiation Center, Cook County Hospital, Chicago, Ill.; Stritch School of Medicine, Loyola University, Chicago, Ill.

[4] Clinical Director, U. S. Public Health Service Hospital, Carville, La.

[5] Former Medical Officer in Charge, U. S. Public Health Service Hospital, Carville, La.

account of its treatment by x-rays, in 1906. He had irradiated 13 patients and listed his results as showing 3 cured, 7 improved, and 3 unimproved. He observed that irradiation of one leprous spot produced improvement in untreated spots elsewhere in the body and stated it as his belief that leprosy bacilli are killed by the treatment and that their bodies are reabsorbed into the blood, producing immunizing and curative factors, as in plague immunization.

A similar study was made during the same year (1906) by Lassar, Siegfried, and Urbanowicz at the Lepraheim in Memel, Germany. Nine patients received roentgen therapy, and regression of local lesions was observed. However, further studies for evaluation of results were recommended. Lassar and his associates gave detailed histories and descriptions of their patients but included no data on the dosage employed.

In 1908, Heiser treated the right ear of a 22-year-old Filipino with roentgen rays and observed one year later that the ear had a normal appearance and that no bacilli could be found. An attempt was also made to treat the nose but, though the nodules disappeared, the organisms persisted.

Matthews (1908) of India was greatly in favor of roentgen therapy for leprosy. He reported 7 cases in detail and observed that six months after the treatment there was marked improvement, with healing of lesions and white scars. He was of the opinion that irradiation was the only method yet tried that had produced any real effect, though it did not afford a permanent cure of the disease.

Disappearance of nodules and healing of ulcers after roentgen therapy were also reported by the French leprologist, Jeanselme, in 1911.

Only a few cases are to be found in the literature for the period 1920–40. Ehrman (1922) reported regression of nodes and improvement of lesions treated with roentgen rays and radium, but observed no effect upon the bacilli. Mitchell (1926) presented a twenty-four-year-old Chinese patient before the Chicago Dermatological Society, in whom 4 1/2 units of roentgen ray exposure to the face had left the lesions unchanged. Camplani (1928) treated lepromatous nodules with roentgen radiation over long periods of time and observed their disappearance. Smidt (1933) recommended small doses for local lesions.

Valuable contributions to the study of radiation effects in leprosy were made during more recent years by Sagher and by Sagher and Miterstein, of the University of Jerusalem. Sagher stated in 1944 that, since there is no specific treatment for the disease, one should at least attempt to influence local lesions. This he considered important (1) when the aspect is particularly repulsive; (2) when lesions tend to grow rapidly; (3) when they cause harm to neighboring organs; (4) when they hamper the mobility of joints.

Sagher irradiated eighteen areas on 2 patients, with dosages ranging from 600 to 7,000 r, using the superficial grenz rays with a h.v.l. of 0.02 mm. Al. Leprous infiltrations started to disappear with doses of more than 2,000 r; smaller doses were ineffective. After a year of observation, the treated areas were clinically free from symptoms. It was concluded, therefore, that there is no doubt that a local effect similar to that of carbon dioxide is possible with the use of grenz rays. Sagher noted that, although no new lesions appeared on the treated areas, they did appear on untreated areas of the body. Histologically he found less cellular infiltration, but bacteriologic studies revealed no change in the number or structure of the organisms.

Sagher's observations were continued on 9 patients in 1946, with the application of 5,000 to 10,000 r of grenz rays in fractionated doses to the face, hands, and feet. Two to three months after the institution of therapy there was no recurrence in the irradiated areas, though new lesions sprang up in the vicinity. Smears demonstrated no effect on the bacilli, but histologic examinations revealed a reduction in the

number of organisms and alterations in their shape. Sagher came to the conclusion that grenz rays exert a definite effect upon lepromatous tissue and that this type of radiation has a place in the local treatment of leprosy.

That small doses of radiation are ineffective can also be concluded from a report by MacKee and Cipollaro (1946), who used unfiltered radiation—75 r per treatment, once a week, for a total of 450 r—with little if any effect.

B. Radium for Superficial Lesions and Cavities: Radium has also been employed for the local treatment of lepromatous lesions. The first report of this procedure was given by de Beurmann and Gougerot at the International Lepra Conference in Bergen in 1909. They observed disappearance of lepromas after radium therapy, noted improvement of the eye after treating lepromas of the cornea, and found that neuritic pains were lessened. A good local effect was also seen by Dekeyser in 1911. In the same year, Brault observed healing of ulcers and disappearance of nodules.

Sandes (1912) had dosage difficulties with radium. He believed that radium had a definite inhibitive action on the vitality and growth of the lepra organism, but in practice no benefit was observed unless treatment was continued for so long as to lead to severe local devitalization of the tissues of the host. The bacilli seemed to have as much resisting power or to be no more susceptible to the rays than the cells among which they lived.

De Verteuil (1914), on the other hand, observed a granular degeneration of the bacillus two weeks after a radium application of 80 mg. for one hour to a lepromatous nodule. He believed that this was an indirect effect due to tissue changes. Another case of healing of a node after radium treatment was reported by Zedell in 1915.

Sandidge (1927) used radium for the treatment of intranasal lesions and for superficial nodules. Among 10 nasal cases, with 7 controls, he obtained marked improvement in the mucous membranes. Fourteen skin nodules disappeared after radium application, while an equal number of control lesions showed no changes. Bacilli were not influenced, but no recurrences were observed. Sandidge recommended radium for local therapy, advising care to avoid overdosage.

C. Roentgen Rays for Neuritis: Deep roentgen radiation in fractionated doses has been found useful in the treatment of neuritis in leprosy. Radaeli (1920) and Truffi (1929) reported good results in the amelioration of root pains over the spine. Hopkins (1926) stated that in acute neuritis, filtered doses of x-rays apparently gave relief in a certain number of cases.

D. Radiation Therapy of Eye Lesions: De Beurmann and Gougerot, as previously mentioned, recommended the radium treatment of lepromas of the cornea as early as 1910. No subsequent attempts were made until Sagher and Miterstein reported in 1947 that lepromas of the bulbar conjunctiva, close to the limbus, are somewhat amenable to local therapy, unless the process has penetrated too far into the eye or originates from the ciliary body. In 3 sightless patients, lepromas became smaller or disappeared after grenz-ray irradiation with single doses of 700 to 1,200 r, and a total of 5,500 to 11,600 r. In 2 other patients good local results were obtained; a third benefited only in a limited area. Patients were observed for four years, and no damage to the lens or cornea was seen.

Kirwan, in a report to the Royal Society of Tropical Medicine on eye lesions in leprosy, in 1948, stated that lepromas of the limbus are amenable to local therapy, such as surgery, diathermy, and carbon dioxide, but indicated that the best treatment is irradiation with grenz rays. He recommended giving 700 to 1,200 r daily, up to a total dose of 5,500 to 11,600 r.

Except for recent work, it is impossible to estimate accurately the radiation doses used by various authors. In general, however, poor results are reported by those

Fig. 1. Height of radiation reaction after three weeks. Area 4 received 3,000 r in air; Area 5, 6,000 r in air. Nodule above Area 4 not treated. Case I: Lepromatous leprosy in a 47-year-old white male. Multiple nodules of the right knee.

Fig. 2. Same case as Fig. 1. Result after two years. There is marked improvement of Areas 4 and 5, with regression and flattening of the irradiated lesions. The untreated nodule above Area 4 has greatly increased in size and has invaded the previously irradiated area.

using small doses and good results by those using larger doses.

In view of the great improvement of radiation equipment and greater availability of sources of ionizing radiation produced in atomic piles, a re-evaluation of the effect of ionizing radiation on lepromatous lesions, with accurately measured doses, was deemed advisable.

MATERIAL AND METHODS

Through the combined efforts of the medical staff of the U. S. Public Health Service Hospital at Carville, La., Dr. G. Halsey Hunt, Asst. Surgeon General of the U. S. Public Health Service, and Dr. James A. Doull, Medical Director of the Leonard Wood Memorial at Washington, D. C., arrangements were made for a pilot study on the effects of roentgen radiation on lepromatous lesions in a few selected patients whose treatment was not otherwise changed. Since no x-ray therapy equipment was available at Carville, the authors arranged to transport their own Phillips contact therapy machine from Chicago to the hospital by car. This unit operates at 50 kv., 2 ma., and has a tube permitting operation at 18 mm. anode-skin distance. With these factors, the output of the tube is 10,000 r per minute. The half-value layer is 0.3 mm. aluminum. The depth dose at 5 mm. is 50 per cent of that at the surface; at 10 mm. depth, it is 23 per cent, and at 40 mm., 1 per cent. This is almost identical with the depth dose of radium, the only difference being that the output of radiation is much higher. It is possible to deliver 1,000 r in six seconds, which makes this tube particularly suitable for this type of study.

Six patients with lepromatous leprosy were selected for this series, and 23 different areas were treated with single doses of contact radiation, ranging from 1,000 to 6,000 r. Clinical changes were observed three weeks after the treatment, when the radiation reaction was at its height, and two months, six months, one year, and two years later.

CASE REPORTS

CASE I (No. 1050): This white male patient was born in 1904. The onset of his illness occurred in 1927, and he was admitted to Carville in 1935 with moderately advanced lepromatous leprosy. The lepromatous lesions remained relatively stationary during several years of chaulmoogra oil therapy. The patient became subjectively and objectively worse during several months of diphtheria toxoid injections in 1941.

Promin was given intravenously between 1942

and 1952 for a total of 4,284 gm. In the summer of 1942, when Promin therapy was started, the patient still showed widespread nodular lepromatous involvement of the skin. From 1942 to 1949 clinical progress was satisfactory, and by the latter date the skin lesions had been largely replaced with atrophic scarring. By November 1949, eight consecutive monthly skin scrapings from various parts of the body had failed to show *M. leprae*. In that month examination revealed large numbers of the organism in new lepromatous lesions on the left buttock and the right elbow. This exacerbation of lepromatous lesions continued unabated from 1949 through 1953, during treatment regimens which included sulfone drugs and INH compounds. Many of the nodules of the extensor surfaces broke down and formed ulcerating masses.

Radiation therapy in dosages ranging from 2,000 to 6,000 r was directed at five of the nodular lepromata. Three small nodules of the buttocks, measuring about 5 mm. in diameter and about 3 mm. in thickness, received doses of 2,000 r, 4,000 r, and 6,000 r. Two slightly larger lepromata of the right knee were treated with 3,000 and 6,000 r.

After the initial period of radiation reaction, the lesion treated with 2,000 r reverted to its pretreatment status and persisted unchanged during the two-year observation period. All of the remaining lesions, receiving 3,000 r, 4,000 r, and 6,000 r, showed marked improvement. One lesion of the right knee became incorporated in a growing adjacent and nontreated lesion (Figs. 1 and 2).

Repeated scrapings from treated lesions continued to show *M. leprae* at all times. On some occasions specimens taken from the irradiated and flattened nodules showed fewer and on other occasions more organisms than did similar untreated control lesions.

One year after radiation therapy, biopsies were studied from one control lesion and from one lesion which had received 4,000 r. The histopathologic reports were as follows:

Treated Lesion: Leprosy, lepromatous, undergoing atrophy, but still active (Fig. 3).

Control Lesion: Leprosy, lepromatous, very active (Fig. 4).

CASE II (No. 1361): This white male patient was born in 1909. The onset of his illness occurred in 1939 and he was admitted to Carville in 1940 with lepromatous leprosy evidenced by discrete lepromata of the forehead, ears, nose, shoulders, knees and elbows, moderate infiltration of the face, and anesthesia from the mid-forearm and mid-leg distalward.

Chaulmoogra oil was given from 1940 to 1944 and eight injections of diphtheria toxoid were given during 1941 and 1942. Sulfone drugs were administered from 1942 to 1952.

Clinical improvement was satisfactory during the period 1944 to 1950. By July 1950, eleven monthly examinations had failed to show *M. leprae* in skin scrapings. At examination in that month, a new conglomerate group of lepromatous nodules of keloid consistency were seen in the left epigastric region and scrapings from this area showed large numbers of *M. leprae*.

From 1950 to 1953 (during Thiosemicarbazone, INH, Dihydrostreptomycin and PAS regimens) this patient showed a wide extension of new lepromatous lesions over the entire body. Many of the lesions of the upper extremities became ulcerated.

Eight lepromatous nodules varying from 4 to 10 mm. in diameter and from 2 to 4 mm. in thickness were exposed to radiation therapy in May 1951. Dosages ranged from 1,000 to 6,000 r. After the initial radiation erythema had subsided, flattening was noted in all treated lesions. Repeated skin scrapings, however, continued to show *M. leprae* in approximately the same numbers as control lesions. On a few occasions the markedly flattened treated lesions contained more organisms per specimen than did unirradiated lesions.

CASE III (No. 1955): This white male patient was born in 1933. The onset of leprosy occurred in 1945 with the appearance of ringworm-like lesions on the lateral surface of the right leg. Similar lesions gradually developed on both legs and both buttocks The patient was admitted to Carville in 1948 with lepromatous leprosy characterized by diffuse infiltration of the face, buttocks, and legs, and infiltrated macules on the chest, abdomen, back, and upper extremities.

Treatment included Promacetin from 1948 to 1951. At the end of approximately thirty-four months of Promacetin treatment it was noted that the lepromatous lesions were showing a rather marked exacerbation, with a heavy florid infiltrated generalized skin eruption, which showed large numbers of *M. leprae*. The patient was given Tibione from April 1951 to December 1951, Sulphetrone from January 1952 to May 1952, and Diasone from May 1952 until he left the hospital with active lepromatous leprosy in September 1952.

Three plaques in the epigastric area were treated with 1,000 r, 2,000 r, and 3,000 r in May 1951. After a moderate degree of radiation erythema had subsided, the treated areas showed flattening and depigmentation.

This patient was last seen in April 1953, when he reported for a follow-up examination. The diffuse skin infiltration was less prominent, and there were light coral-colored plaques over the anterior chest wall. The irradiated sites over the epigastrium were visible. The area treated with 1,000 r was scarcely discernible; that treated with 2,000 r showed marked depigmentation at the center with a peripheral halo of tan pigmentation; the area treated with 3,000 r also showed a depigmented center with tan border. Skin scrapings from treated and untreated areas showed a moderate number of *M. leprae*. Biopsies were not obtained. During the

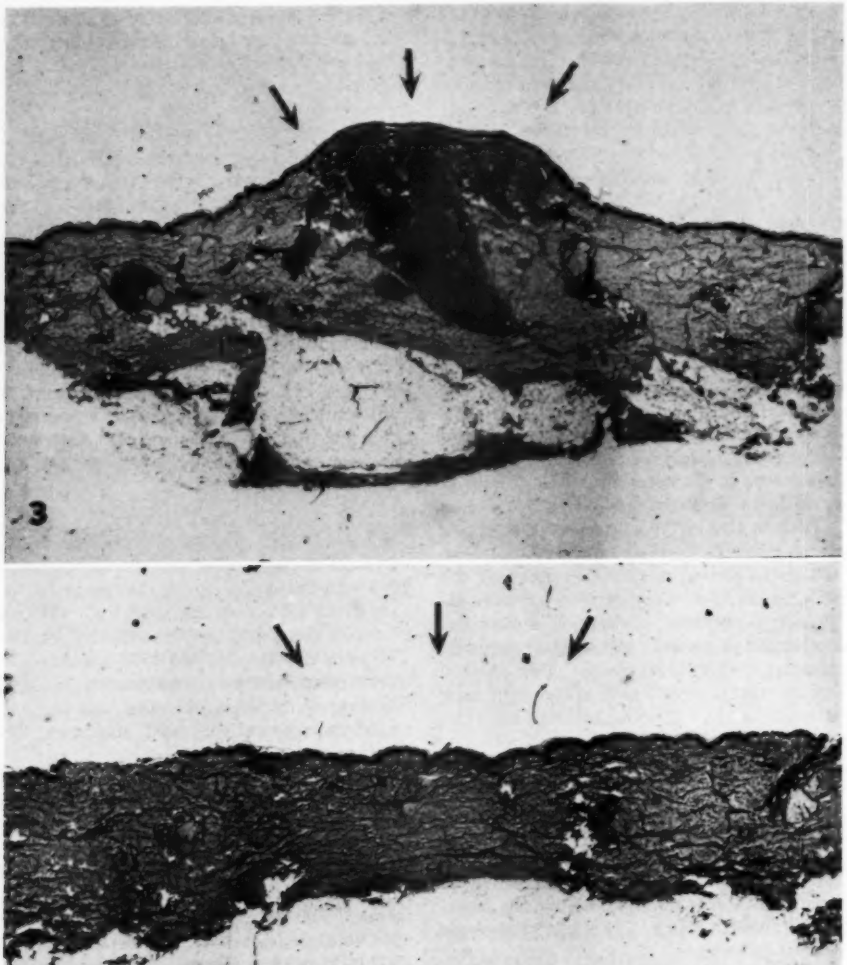

Fig. 3. Lepromatous nodule of abdomen untreated. Note extensive changes of the epidermis and cutis.

Fig. 4. Lepromatous nodule of abdomen after treatment with 4,000 r in air. The nodule has disappeared. The epidermis is intact. Active disease is still present in deeper seated subcutaneous tissues and in areas to the sides, not subjected to irradiation.

period 1951 to 1953 this patient's skin lesions showed clinical remission, but in all the disease process continued active.

CASE IV (No. 2034): This patient was born in 1885. In 1939 a diagnosis of syphilis was made because of a positive serologic test, and antisyphilitic treatment was given until January 1942. Almost immediately upon institution of this treatment, in 1939, nasal occlusion developed and nodules began to appear on the skin. The patient was first admitted to Carville in March 1942, with lepro-

matous leprosy evidenced by discrete nodules of the ears, face, buttocks, and extremities. His eyes were grossly normal at that time. Treatment included chaulmoogra oil from March 1942, until the patient absconded in October 1942.

The patient was again admitted in 1949, by which time his lepromatous leprosy had extended considerably and had caused sufficient eye damage to permit light perception only. Treatment included Dihydrostreptomycin during 1950 and Terramycin and Diasone during 1951. From 1951 to 1953 Diasone alone was administered. During approximately three years of sulfone therapy the skin lesions showed some clinical improvement, but disease activity persisted and all skin scrapings continued to show *M. leprae*. The patient left the hospital with active lepromatous leprosy in January 1953.

Three small nodules of the epigastric region were treated with 1,000 r, 2,000 r, and 4,000 r in May 1951. After the radiation erythema had subsided, atrophic scars developed at the sites of treatment. At the end of one year the area treated with 1,000 r was unchanged, while the other two areas showed moderate flattening. Untreated lesions were also undergoing flattening and atrophy.

In June 1952, biopsies from the lesion treated with 4,000 r and from an untreated lesion were studied. In spite of the flattening of the treated nodule, which was clinically evident, active lepromatous leprosy was present.

CASE V (No. 2047): This white female patient was born in 1934. Her first symptom was a red macule appearing on the right cheek in December 1948. She was admitted to Carville in December 1949, with lepromatous leprosy evidenced by infiltrated macules of the face, arms, legs, and buttocks, ranging from 1 to 10 cm. in diameter.

Treatment included hydroxyethylsulfone from December 1949 to July 1950, and Diasone from July 1950 through 1953. With sulfone therapy there was a gradual fading of all lesions.

Radiation in dosages of 1,000 r, 2,000 r, and 3,000 r was applied to three macules on the thighs in May 1951. An erythematous reaction occurred in all treated areas, and the lesions which had received 2,000 r and 3,000 r showed some degree of central necrosis. At the end of two years of observation it was concluded that the irradiated as well as the untreated macules had all faded. The treated areas could be identified by their slight pigmentation. *M. leprae* continued to be demonstrated in both treated and untreated lesions.

CASE VI (No. 2123): This Hawaiian female was born in 1927. Her illness had its onset in February 1951, with the appearance of a red pimple on the left cheek. The lesion was removed surgically, and a diagnosis of leprosy was based on histopathologic findings. The patient was admitted to Carville

Fig. 5. Height of a radiation reaction after three weeks, 3,000 r in air. Case VI. Lepromatous leprosy in a 24-year-old Hawaiian female. Small nodule over the right heel cord.

April 16, 1951, with a diagnosis of lepromatous leprosy evidenced by three small lepromata over the right heel cord and anesthesia of the right forearm. She was treated with Sulphetrone from the time of admission to August 1953, when she left the hospital with active lepromatous leprosy. The minimal lesions progressed satisfactorily during two and one-half years of sulfone therapy, but persistence of leprous activity was evidenced by the continued finding of *M. leprae* in all skin scrapings.

A small nodular lesion of the right heel cord region was irradiated with 3,000 r in May 1951. Slight vesiculation accompanied the erythematous reaction, and a small dressing was required for a few weeks (Fig. 5). Thereafter the lesion showed a marked degree of flattening, with a white center and pigmented periphery. *M. leprae* were found in the treated area on all examinations during a two-year period of observation.

To summarize, 6 patients, 4 male and 2 female, ranging in age from sixteen to sixty-seven years, were treated. Four had nodular skin lesions, 1 plaques, and 1 macules. A total of 17 nodules were treated, 3 macules, and 3 plaques. All the nodules were small, measuring about 5 × 4 mm. and about 2 to 3 mm. in thickness. The irradiated plaques and macules were slightly elevated, measuring 2.5 cm. in diameter.

TABLE I: LOCAL RESULTS OF RADIATION THERAPY AFTER TWO YEARS

Dosage	Reg. No.	No. Lesions	Clinical Appearance of Lesion			
			Unchanged	Slight Improvement	Moderate Improvement	Marked Improvement
1,000 r	1361, 1361,* 1955, 2034, 2047	5	1	..	..	4
2,000 r	1361, 1361, 1050, 1955, 2034, 2047	6	1	1	1	3
3,000 r	1050,† 1955, 2047, 2123	4	..	..	..	4
4,000 r	1050, 1361, 1361, 2034	4	..	1	1	2
6,000 r	1050,* 1050, 1361,* 1361*	4	..	..	..	4
	TOTAL	23	2	2	1	17

* Excised for biopsy study.
† Invaded by adjacent lepromatous nodule.

RESULTS

Single massive doses of 1,000 to 6,000 r in air were administered to nodules and 1,000 to 3,000 r in air to plaques and macules. Radiation erythema, of various degrees, was seen in all patients during the first few weeks following treatment (Fig. 5). Central necrosis was observed in 9 treated lesions receiving 2,000 r or more. Pigmentation changes were observed in all patients treated. In the lower dosage range, there was usually slight hyperpigmentation. With higher dosages, depigmentation of the central portion of the lesion was associated with a halo of hyperpigmentation.

Most of the treated lesions were examined repeatedly during a two-year period. One patient was lost to observation at the end of sixteen months. Atrophy, fading, and flattening were noted in all but 2 of the treated lesions, which had received 2,000 r or less (see Table I).

Skin scrapings were taken from treated lesions repeatedly. During the period of observation there was no indication that *M. leprae* were decreased in number or changed in morphology in treated as compared with untreated lesions of the same patient. In Cases I and II, specimens obtained from treated and somewhat flattened lepromatous nodules contained more *M. leprae* per high-power field than were found in specimens from similar untreated nodules of the same patient.

Six treated and control lesions were excised for histopathologic study at the end of one and two years of observation. Although the irradiated lesions showed evidence of atrophy, the lepromatous architecture and *M. leprae* were still evident in the surrounding untreated tissue, and the final histopathologic diagnosis in all cases was "lepromatous leprosy, active."

As expected, there was no change in the general course of the disease. Two of the patients were undergoing serious relapses at the time treatment was administered. The relapses, manifested by innumerable new lepromatous nodules, have continued more than two years after treatment. Recurrences have not appeared in irradiated areas, but in one instance (Case I) an adjacent untreated nodule progressed sufficiently to engulf the previously irradiated area. Four of the patients in this series were showing satisfactory clinical progress when radiation therapy was used and have continued to show some degree of remission since that time. Most of the treated lesions of patients in remission showed more atrophy than did comparable untreated lesions.

DISCUSSION

In order to understand and evaluate properly the results obtained, it is necessary to realize the limitations of the radiation source used in this pilot study. Due to the short anode-surface distance and the low voltage used in contact roentgen therapy, the half-value layer in tissue is only 5 mm. Therefore, the radiation effect observed is limited and very superficial. Treating with this method a superficial nodule measuring 3 to 5 mm. in

height and having a diameter of 5 to 8 mm., one can expect destruction only of the nodule itself, without effect upon lepromatous foci in the deeper underlying or surrounding tissue (Figs. 3 and 4). In other words, such radiation cannot bring about a change in the general histopathologic architecture of the diseased skin. This has been indicated by our limited biopsy studies, and may be one reason why the two lesions receiving 2,000 and 4,000 r, respectively, showed only slight improvement after two years. Both of these lepromatous nodules were relatively thick. It is quite possible that, with rays of a more penetrating quality, radiation effects would be observed in a larger volume of tissue. We have determined that 2,000 r can be effective in causing atrophy and regression of lepromatous tissue.

In a disease of so chronic a nature, the course of which is punctuated by periods of remission and relapse, a much longer period of observation will be necessary before the end-results of local radiation therapy can be known. Further studies with different qualities of radiation and different methods of application therefore seem desirable. The lack of available radiation therapy equipment at Carville makes any continued research work on this project impossible for the present time. It is hoped, however, that eventually facilities will be such as to permit further studies.

CONCLUSIONS

1. Ionizing radition is effective in causing flattening and atrophy of lepromatous skin lesions.

2. At least 2,000 r are required to cause such changes.

3. Ionizing rays do not cause any uniform change in bacillary findings.

4. Contact roentgen irradiation affects only superficial structures of the skin. In the doses used it does not cause atrophy or regression of lepromatous lesions in the dermis or subcutaneous tissues.

5. No local recurrences were observed in irradiated areas during a two-year observation period.

6. Irradiated areas can be invaded by growing adjacent lepromatous lesions.

7. Local radiation effects on skin lesions do not change the general course of leprosy.

SUMMARY

A review of the literature on the subject of radiation in leprosy is presented.

Twenty-three lepromatous lesions of 6 patients were treated with single doses of superficial contact roentgen radiation, ranging from 1,000 to 6,000 r in air, and were observed for two years. Flattening of all but 2 of the treated lesions was noted.

Histologic studies failed to reveal evidence of radiation damage.

Repeated skin scrapings of irradiated areas failed to show any decrease in number or change in morphology of *M. leprae*.

Department of Radiology
Carle Hospital Clinic
Urbana, Ill.

BIBLIOGRAPHY

BELOT, M.: Les rayons X dans la lèpre. Ann. de dermat. et syph. **5:** 533–534, 1904.

BRAULT, J.: Quelque réflexions sur certains traitements actuellement usités dans la lèpre. Ann. de dermat. et syph. **4:** 811–816, 1903.

CAMPLANI, M.: Singolare reazione cutanea in lebbroso trattato con raggi X. Riforma med. **44:** 314–319, March 19, 1928. Abst. in Arch. Dermat. & Syph. **18:** 143, 1928.

DE BEURMANN AND GOUGEROT: Traitement de la lèpre. II. De l'emploi du radium dans le traitement des lepreux. Lepra, Bibl. Internat. **11:** 301–303, 1910.

DEKEYSER, L.: Considérations sur la lèpre aux Iles Hawai. Monographia, Bruxelles, 1911.

DE VERTEUIL, F. L.: Die Wirkung des Radiums auf den Leprabazillus. Strahlentherapie **4:** 647–648, 1914.

EHRMAN, N.: Lepra maculosa et tuberosa in sanatione. Dermat. Wchnschr. **75:** 1247, 1922.

HEISER, V. G.: Preliminary Notes upon a Case of Leprosy Apparently Cured with the X-rays. M. Record **74:** 757–758, 1908.

HOPKINS, R.: Leprosy with Special Reference to Self-Limiting Phases of the Disease. South. M. J. **19:** 784–790, November 1926.

JEANSELME, E.: Les nouvelles médications antilepreuse. Lepra, Bibl. Internat. **12:** 237–243, 1911.

KIRWAN, E. O.: The Eye in Leprosy. Tr. Roy. Soc. Trop. Med. & Hyg. **41:** 583–590, March 1948.

KLINGMUELLER, V.: Die Lepra. In Handbuch der Haut- und Geschlechtskrankheiten **10:** 728–729, Berlin, Julius Springer, 1930.

LASSAR, O., SIEGFRIED, A., AND URBANOWICZ: Bericht des Kreisarztes Urbanowicz über Versuche mit der Behandlung Leprakranker mit Röntgenstrahlen. Dermat. Ztschr. **8:** 690–712, 1906.

LIE, H. P.: Die Therapie der Lepra. Deutsche med. Wchnschr. **30:** 1381–1384, 1904.

MACKEE, G. M., AND CIPOLLARO, A. C.: X-rays and Radium in the Treatment of Diseases of the Skin. Philadelphia, Lea & Febiger, 4th ed., 1946.

MATTHEWS, G. A. C.: Treatment of Leprosy with X-Rays and High Frequency. Lepra, Bibl. Internat. **8:** 244–245, 1909.

MITCHELL, J. A.: Society Transactions. Chicago Dermatological Society, May 20, 1926. Arch. Dermat. **15:** 76, 1927.

MORRIS, M., NICHOLLS, AND DORE: A Case of Leprosy Treated with a Special Vaccine and with X-rays. Brit. J. Dermat. **20:** 416, 1908.

OUDIN: Lèpre tuberculeuse traitée par les rayons X. Lepra, Bibl. Internat. **4:** 212–215, 1904.

PERNET, GEORGE: Discussion on the Comparative Value of the Old and New Methods of Treating Lupus Vulgaris and Certain Other Skin Diseases. Internat. M. J. **2:** 985, 1904.

PERNET, GEORGE: The Treatment of Leprosy. II. Internat. Lepra Konferenz, Bergen 1909. Lepra, Bibl. Internat. **11:** 239–240, 1910.

RADAELI, I. F.: La diffusione della lebbra in Sardegna ad il primo esperimento di lotta antilebrosa eseguito in Italia. Gior. ital. dermat. **61:** 319–327, 1920.

ROGERS, L., AND MUIR, E.: Leprosy. Baltimore, Williams & Wilkins Co., 3d ed., 1946.

SAGHER, F.: The Effect of Grenz Rays on Leprous Infiltrations: Report of an Attempt to Influence Facies leontina and Perforating Ulcer of the Foot by Roentgen Rays of Long Wavelength. Dermatologica **93:** 272–294, 1946.

SAGHER, F.: Effect of Grenz Rays on Leprous Infiltrations: Report of an Attempt to Influence Leprous Infiltrations by Roentgen Rays of Long Wavelength. Arch. Dermat. & Syph. **50:** 311–314, November 1944.

SAGHER, F., AND MITERSTEIN, B.: Effect of Grenz Rays on Leprous Infiltrations: Response of Lesions of Anterior Portions of Eyeball. Arch. Ophth. **38:** 78–88, July 1947.

SANDES, T. L.: Experimental Treatments for Leprosy. J. Trop. Med. & Hyg. **15:** 65–70, 1912.

SANDIDGE, R. P.: Studies Upon Leprosy. Public Health Bulletin No. 168, 1927.

SCHÄFFER, J.: Behandlung der Haut-und Geschlechtskrankheiten. Berlin & Wien, Urban & Schwarzenberg, 1932.

SCHNEIDER, K.: Einiges über das Memeler Leproheim und die Lepraendemie im Kreise Memel. Deutsch. med. Wchnschr. **68:** 615, June 12, 1942.

SMIDT, H. N.: Roentgenotherapy of Leprosy. Geneesk. tijdschr. v. Nederl.-Indie **72:** 1690–1704, Dec. 6, 1932.

TRUFFI, G.: Le applicazioni spinali di raggi X nei lebbrosi e nei tabetici ed il loro meccanismo di azione. Gior. ital. di dermat. e sifl. **70:** 573–584, June 1929.

STRONG, R. P.: In Stitt's Diagnosis, Prevention and Treatment of Tropical Diseases. Philadelphia, The Blakiston Co., 6th ed., 1942, pp. 869–870.

WILKINSON, H. B.: Leprosy in the Philippines with an Account of Its Treatment with the X-ray. J.A.M.A. **46:** 315–321, 1906.

ZEDELL, C. E.: Leprosy Treated with Radium and Diathermy. Arch. f. Schiffs- und Tropenhygiene **19:** 291, 1915.

SUMARIO

El Efecto de los Rayos X sobre la Lepra Lepromatosa

Repásase la literatura relativa a la radioterapia en la lepra y se presentan los resultados obtenidos con los rayos X en 6 leprosos.

Veintitrés lesiones lepromatosas recibieron dosis únicas de rayos X en contacto superficial, que variaban de 1,000 a 6,000 r al aire. Los sujetos fueron observados durante dos años. Con excepción de dos, se aplanaron todos los nódulos tratados y no hubo recurrencias locales en las zonas irradiadas, aunque éstan pueden ser invadidas por lesiones lepromatosas adyacentes en vías de desarrollo.

No se logró modificar la evolución general de la dolencia y repetidos raspados cutáneos de las zonas irradiadas no revelaron disminución del número ni alteración de la morfología de los *M. leprae*.

Los estudios histológicos realizados no revelaron el menor signo de lesión irradiatoria.

The Value of Radiation Therapy in the Management of Intrinsic Tumors of the Spinal Cord[1]

ERNEST H. WOOD, M.D.
Chapel Hill, N. C.
and
ALFRED S. BERNE, M.D., and JUAN M. TAVERAS, M.D.
New York, N. Y.

INTRINISIC TUMORS of the spinal cord arise from neuronal tissue, glial cells, vascular structures, and occasionally from other cellular components of the spinal medulla. Tumors which arise from the meninges and nerve root sheaths or which result from the developmental inclusion of foreign dermal, fibrous or adipose tissue within the substance of the spinal cord are not truly intrinsic tumors. As in the brain, the majority of primary intrinsic spinal cord tumors are gliomas, but the growth characteristics and effects upon the host are not the same. It is the purpose of this paper to analyze the case histories of a relatively large number of patients with primary spinal cord tumor and to evaluate the effect of radiation therapy upon the course of the disease.

INCIDENCE AND PATHOLOGY

It is difficult to establish definitely the relative incidence of intraspinal tumors, either in comparison with intracranial tumors or with other neurologic diseases, since necropsy material, even in large metropolitan hospitals, is meager and unrepresentative. Gliomas of the spinal cord, however, are encountered much less frequently than their intracranial counterparts. In an attempt to establish a ratio, 500 consecutive surgically verified central nervous system glial tumors encountered at the Neurological Institute of New York in recent years were analyzed, with the result that 7 per cent were found to originate within the spinal cord. The incidence is higher than that reported earlier by Wolf (16), Elsberg (6), and others. A possible explanation of the current high incidence is the refinement of neurologic and radiologic diagnosis, and the use of myelography, in particular, to differentiate expanding spinal lesions from degenerative diseases (Figs. 2 and 3).

An indication of the relative frequency of intrinsic new growths in relation to all spinal cord tumors is gained from an analysis of the large series of 979 intraspinal neoplasms studied by Woltman, Kernohan, Adson and Craig (17). These investigators found that 22.5 per cent of this group of almost a thousand spinal tumors were gliomas. Approximately 56 per cent were schwannomas and meningiomas; the remainder, aside from the glial tumors, comprised extradural sarcoma, hemangioma, chordoma, dermoid, and neoplasms of miscellaneous tissue types.

Regardless of the histologic nature of spinal cord glioma, the gross pathologic change is an enlargement of the spinal cord within its pial covering and derangement of normal topography. Since the tumors infiltrate and expand the medullary substance (but generally are retained by the pia mater), their longitudinal extent may involve several spinal segments, with the result that externally the appearance often is a fusiform enlargement of the spinal cord (Fig.1). Usually the involved cord is pale or purplish; if tumor presents at the cord surface, it may appear grayish white, reddish gray, or reddish blue. There is often a marked increase in the number and size of blood vessels in the

[1] From the Department of Radiology of the College of Physicians and Surgeons, Columbia University, and the Radiological Service of the Neurological Institute, New York, N. Y. Presented at the Thirty-ninth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 13–18, 1953.

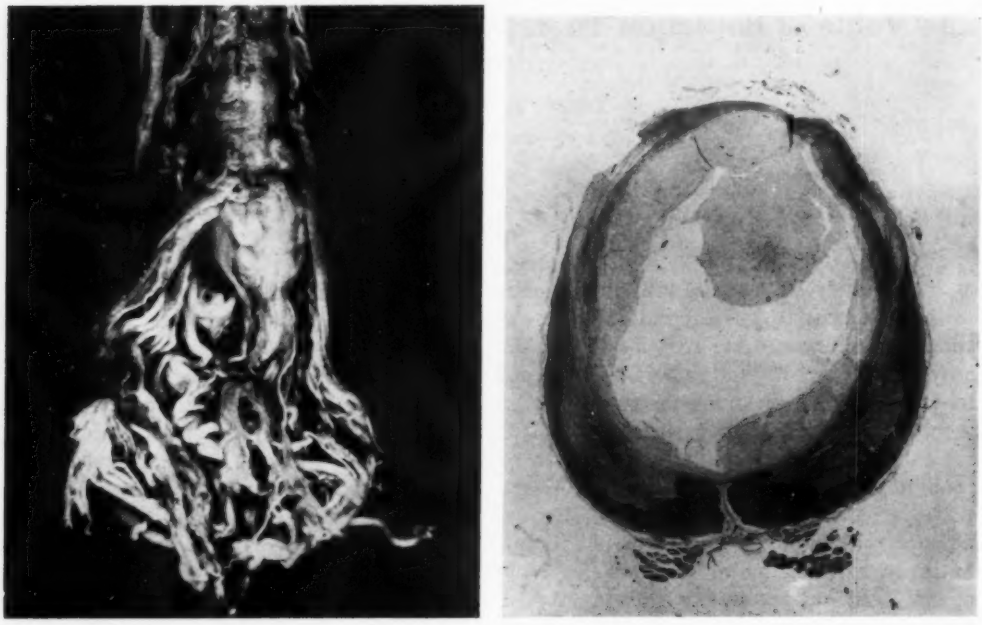

Fig. 1. Ependymoma of the conus medullaris. In the view on the left the spinal nerve roots comprising the cauda equina are drawn aside to reveal the lower end of the spinal cord. The conus medullaris is markedly enlarged and appears bulbous rather than narrow and tapered. A cross section of the specimen (right) discloses extensive cystic degeneration of the neoplasm. The peripheral medullary tissue is deformed and compressed by the large central mass. The posterior and lateral portions of the spinal cord in particular are flattened and normal cell columns and nerve fasciculi have been destroyed. (Courtesy of Dr. Abner Wolf)

tumor area and evidence of subpial hemorrhage may be seen. On cut section the diameter of the spinal cord is increased, and the major tracts may be deformed and distorted beyond recognition. Areas of hemorrhage and cystic degeneration are common. Tumors of the cauda equina may grow irregularly among the spinal nerve roots, although often the tumors are encapsulated by a thin connective-tissue membrane of leptomeningeal origin (Fig. 3). Cystic degeneration occurs less commonly in ependymoma than in astrocytoma.

The same types of glioma are found in the spinal cord as in the brain, but not in the same proportions. Ependymal tumors have a much higher relative incidence in the spinal cord, especially at the caudal end. The anatomic occurrence of large numbers of ependymal cells lining the terminal ventricle of the conus medullaris and the core of the filum terminale is a logical explanation of the high incidence of ependymal new growths affecting these structures. Following ependymoma, astrocytoma is encountered most frequently. Occasional examples of oligodendroglioma, medulloblastoma, and more primitive tumors, such as glioblastoma multiforme, have been reported. Hemangioblastoma, which arises from vascular structures within the medullary substance itself, is found infrequently.

MATERIAL

The 62 verified cases available for analysis comprise a group of 39 pathologically classified tumors and 23 in which the diagnosis was established only by surgical gross inspection without removal of tissue. Of the 39 histologically classified tumors, approximately two-thirds were ependymoma and approximately one-third were astrocytoma, while 4 patients had miscellaneous tumors, 2 of which were lipomas (Table I). The preponderance of ependymoma over astrocytoma in a ratio

of 2:1 conforms to the higher incidence of ependymoma in the spinal cord often reported previously. Of 101 spinal gliomas described by Woltman *et al.*, 63 were ependymoma and 38 astrocytoma. For convenience, the tumors will be divided into four groups, *viz.*, ependymoma, astrocytoma, miscellaneous, and unclassified.

TABLE I: FREQUENCY OF HISTOLOGIC TYPES AMONG 62 VERIFIED INTRINSIC TUMORS OF THE SPINAL CORD

Type	Number
Ependymoma	23
Astrocytoma	12
Miscellaneous	
Lipoma	2
Hemangioblastoma	1
Mesenchymoma	1
Unclassified	23
TOTAL	62

Age: The average age of the entire group of patients, when first seen, was thirty-seven years. The average for the ependymoma group was thirty-eight years, for the astrocytoma group thirty-seven, and for the unclassified group thirty-eight. Thus, it is apparent that spinal gliomas of all types occur earlier in life, on the whole, than do primary tumors of the majority of other organs. Five patients with spinal glioma were seen after the age of sixty years. It is of interest and possibly of significance with regard to relative benignancy, that only one patient with ependymoma appeared for medical treatment before the third decade, and in only one other instance did the history reveal symptoms that antedated the twentieth year (Table II).

TABLE II: AGE DISTRIBUTION OF 62 PATIENTS WITH INTRINSIC SPINAL CORD TUMOR

Age	Ependymoma	Astrocytoma	Miscellaneous	Unclassified	Total
0–9	..	2	..	2	4
10–19	1	..	..	4	5
20–29	9	1	2	1	13
30–39	4	3	..	5	12
40–49	5	3	1	4	13
50–59	3	2	1	4	10
60–69	1	1	..	3	5

Fig. 2. Intramedullary glioma. The myelogram discloses a partial obstruction to the cephalad passage of Pantopaque as a result of enlargement of the thoracic spinal cord at the fourth and fifth thoracic vertebral levels. The portion of the spinal cord expanded by the tumor (arrows) appears as a fusiform enlargement of the band of diminished density which represents the thoracic cord.

Sex: Intrinsic spinal cord tumors occurred earlier in men (average thirty-three years) than in women (average forty years). This is at sharp variance with the report of Woltman *et al.*, who found in all of their groupings that women were affected earlier in life than men. The cause for a variation in the age of onset of spinal glioma between the two sexes cannot be postulated. The entire series herein reported comprises 33 men and 29 women, with essentially an even distribution between the sexes in the astrocytoma and

TABLE III: FREQUENCY OF HISTOLOGIC TYPE, WITH SEX AND AVERAGE AGE OF PATIENT FOR 62 PRIMARY INTRINSIC SPINAL CORD TUMORS

Type	Male		Female	
	No.	Av. Age	No.	Av. Age
Ependymoma	15	36	8	35
Astrocytoma	5	37	7	37.5
Miscellaneous:				
Lipoma	1	12	1	17
Hemangioblastoma	..	..	1	42
Mesenchymoma	..	..	1	37
Unclassified	12	29	11	47

unclassified groups (Table III). The more frequent occurrence of ependymoma in men than in women, with a ratio of 15:8 (2:1), corresponds to the observations of prior investigators.

Locus: The common caudal location of ependymoma in our series of cases again is at variance with the analysis of Woltman and his associates, in that the Mayo Clinic series comprised almost twice as many intramedullary ependymomas above the conus as ependymal tumors of the conus and filum terminale (Table IV). The reason for this difference is not clear.

All the unclassified tumors of the current series are intramedullary lesions. This is undoubtedly a result of surgical judiciousness in not damaging functioning portions of the spinal cord for the sake of pathologic classification of the tumor. In these instances the inspection and palpation of an intramedullary mass by experienced neurosurgeons is considered satisfactory verification of diagnosis. In each of the 23 patients with unclassified tumor it was the stated opinion of the surgeon that he was dealing with a solid or partially cystic new growth of the spinal cord. When cysts were evacuated, the fluid was indicative of cystic degeneration of a neoplasm, and no case is included where there was any suspicion of syringomyelia.

METHOD OF TREATMENT

Radiation therapy was administered to each of the 62 patients during the immediate postoperative period. The quality of radiation varied from a half-value layer of 0.95 to 1.2 mm. Cu, which is approximately equivalent to 200-kv. radiation with 1 mm. Cu and 1 mm. Al added filtration. The target-skin distance for all treatments was 50 cm.

The quantity of radiation delivered at each sitting, in the majority of instances, was 200 r as measured in air. Treatment was given daily and continued for varying periods. The total dose delivered and the time of delivery were, therefore, inconsistent. In many instances, repeated series of irradiation were given several months or years after the original course. The variation in total dosage and the usually protracted duration of treatment make quantitative comparison of effective dose from patient to patient difficult. Nevertheless, the treatment record for each case has been analyzed and an attempt has been made to calculate total tumor dosage and time of delivery. Field sizes varied with the location and longitudinal extent of the lesion, but the small diameter of the vertebral canal makes it possible to define accurately the transverse and lateral extent of the pathologic process. The portals were adequate in width to assure that the mid-line depth dose applied to the whole spinal cord, and the minimal tumor dose was delivered to a point between 4 and 6 cm. below the skin surface from a posterior field. The exact depth was determined by physical measurement and checked by corrected measurements from roentgenograms. When lateral, oblique, and occasionally anterior fields were used, appropriate calculations were made. Ra-

TABLE IV: REGIONAL LOCATION OF INTRINSIC SPINAL CORD TUMORS OF VARIOUS HISTOLOGIC TYPES

Locus	Ependymoma	Astrocytoma	Miscellaneous*	Unclassified	Total
Cervical C-1/C-7	0	5	1 (H)	15	21
Thoracic T-1/T-9	0	4	1 (L)	6	11
Lumbar T-10/T-12	0	2	0	1	3
Conus L-1/L-2	16	1	1 (L)	1	19
Filum L-3/S-2	7	0	1 (M)	0	8

* H. Hemangioblastoma. L. Lipoma. M. Mesenchymoma

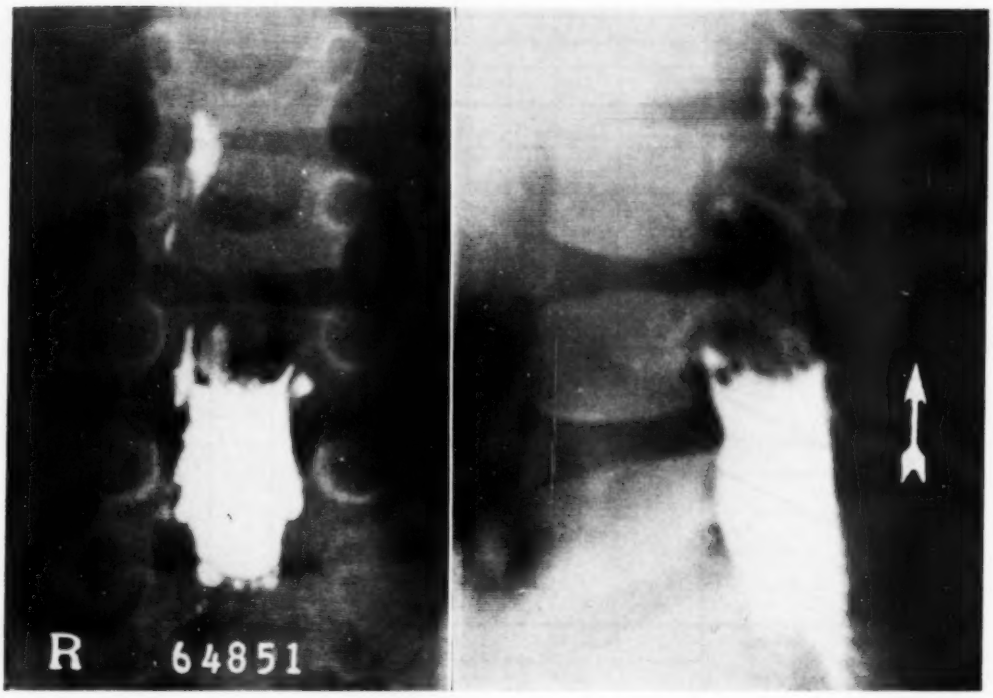

Fig. 3. Extramedullary glioma. The myelogram demonstrates a subtotal obstruction to the cephalad flow of radiopaque material behind the body of the fourth lumbar vertebra. The lower margin of the intradural tumor causes a semilunar indentation of the head of the Pantopaque column. At operation the tumor was found to be an astrocytoma which extended from T-12 to L-4 vertebral bodies and was thought to have arisen from the conus medullaris (Case I).

diation therapy is recorded in terms of total dose to the tumor in relation to time of delivery for each patient (Tables V, VI and VII). In addition, the various quantities of radiation are plotted on a graph, adapted from Boden (3), in order that the general distribution of patients in regard to tumor dose may be appreciated at a glance (Fig. 4). An illustrative case history, describing the events leading to roentgen therapy, the details of treatment, the results of treatment, and the indications for repeated series of irradiation, is also related (Case I, Fig. 3).

CASE I: A five-year-old boy was admitted to the hospital because of lower abdominal pain of two months duration. A gait disturbance had been present from the age of ten months, when he first began to walk. The gait was unsteady and the patient had never learned to climb stairs because he was unable to lift the legs more than a few inches above the floor. During the second and third years of life, walking improved spontaneously and the earlier difficulty was attributed to a congenital muscular abnormality. Two months before admission intermittent pain occurred in the toes of both feet. For one month there had been urgency of urination and defecation.

The patient had an unsteady gait because of weakness of both lower extremities. Muscle atrophy and hypotonia extended as high as the gluteal area. Hypalgesia and hypesthesia were present below the level of the fifth lumbar dermatome. Deep tendon reflexes were absent in both lower extremities. Myelographic examination disclosed a complete obstruction to the cephalad passage of radiopaque material at the level of L-4. The head of the radiopaque column outlined the slightly irregular inferior margin of an intradural tumor (Fig. 3). At operation this tumor was found to involve the spinal cord and cauda equina from the level of T-12 to L-4. Biopsy only was performed, and microscopic examination revealed an astrocytoma.

The patient was referred for radiation therapy seventeen days following the surgical procedure. Roentgen therapy was administered through a single posterior portal, 6 cm. in width and 20 cm. in length, centered over the operative area. Physical factors were: 1.2 mm. Cu h.v.l., 50 cm. target-skin dis-

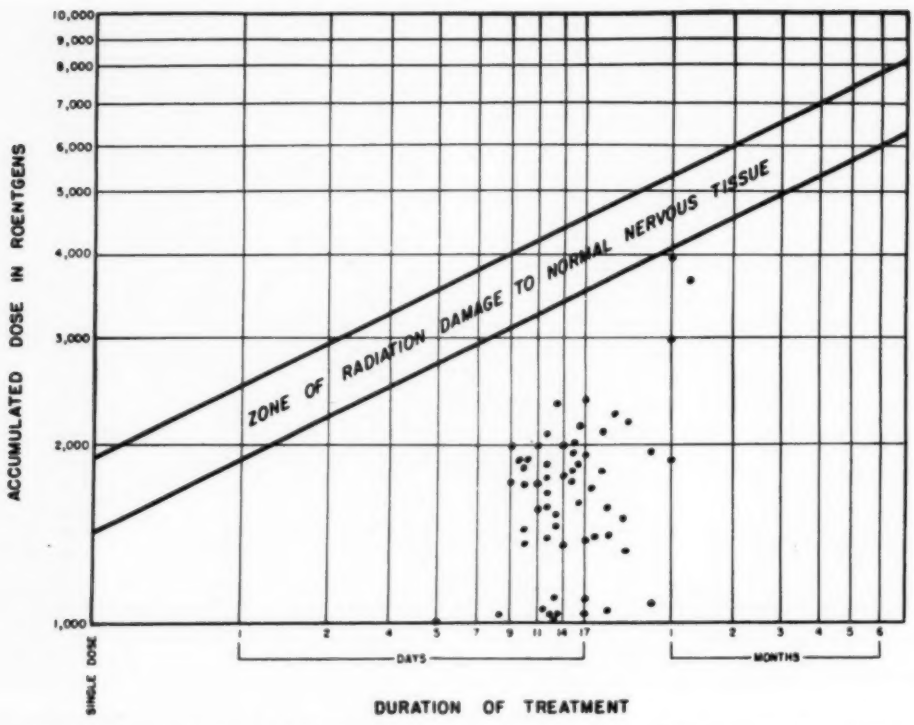

Fig. 4. Time-dose relationship in the treatment of spinal cord tumor. The quantities of radiation used for the treatment of the various patients are plotted in relation to time (after Boden, 3). The median point is a tumor dose of 1,700 r delivered in two weeks.

tance, 56 r per minute as measured in air. Ten daily doses of 200 r in air were administered over a twelve-day period for a total of 2,000 r. The calculated tumor dose at the point of minimal intensity of radiation was 1,700 r in the twelve-day period. A second, similar series of treatments was given six weeks later, with 1,700 r to the tumor administered in ten days.

During the month following the second course of radiation therapy, the patient's walking continued to improve and he became able to ascend and descend stairs with great facility. One week before admission for a third course of radiation therapy, paroxysmal pain again developed in the toes of both feet. The third series likewise consisted of 1,700 r tumor dose administered over a ten-day period, with the same factors as before.

Six months following the third course of irradiation, the patient returned because of lower abdominal pain, especially at night. During the interval he had experienced continued improvement in strength of the lower extremities and only minimal disturbance of gait. Pain in the toes occurred only occasionally. A fourth series of radiation treatments was given to the same area as before, but limited to 1,500 r as measured in air. A minimal tumor dose of 1,275 r was administered over a protracted period of twenty-one days. For the next nine months the patient experienced only occasional pain in the toes, which was never severe. The abdominal pain did not recur. Vesical and rectal sphincter control was good, and the strength of the legs was maintained. A fifth radiation series was given one and one half years after the first because of slight weakness of the right leg, which developed at this time. The fifth series was similar in every respect to the fourth.

In all, the patient received a tumor dose of 7,650 r over eighteen months. The first three series of treatments, which totaled 5,100 r to the tumor over four months, were given with scheduled intervals of six weeks rest between courses. Subsequent treatment was administered only as the clinical condition demanded. The patient was seen in 1953, six years after the first hospital admission and the first course of radiation therapy. He walks well, attends school, and has no pain, although urinary incontinence occurs on rare occasions.

RESULTS OF TREATMENT

The natural course of gliomas of the central nervous system, without surgery

TABLE V: RESULTS OF TREATMENT OF INTRAMEDULLARY TUMORS OF THE SPINAL CORD*

Ependymoma: Twenty-three Patients

Unit No.	Age, Sex, and Locus	Survival in Years	1953 L or D	Radiation Therapy	Remarks
576496	27 F Conus	19	L	1,500 r in 10 d. (× 9 in 15 yr.)	Walks short distances well. Self-employed. Recurrent pain and weakness always relieved by radiation over the years.
816151	55 M Filum	16	L	1,100 r in 12 d. (× 8 in 9 yr.)	Walks with cane; no pain.
582344	28 M Filum	15	L	1,100 r in 19 d. (× 2 in 0.3 yr.)	Walks well and is asymptomatic.
694995	24 M Conus	15	L	1,500 r in 22 d. (× 7 in 6.5 yr.)	Walking and working. No handicap. Mild urinary bladder disorder.
327874	37 F Filum	14	L	1,250 r in 21 d. (× 5 in 1.5 yr.)	Walks well. Does own housework. Asymptomatic but tires easily.
606999	31 F Filum	13	L	1,440 r in 20 d. (× 6 in 4.3 yr.)	Walking and working. Patient states: "I'm doing fine."
606946	16 M Filum	13	L	1,900 r in 17 d. (× 6 in 12 yr.)	Walks well. Numbness left leg and back pain. Recurrent pain in leg relieved by each course of radiation.
614602	44 M Conus	13	L	1,860 r in 30 d. (× 4 in 7 yr.)	Walks well. Recurrent pain in back and legs; suprapubic cystostomy.
640813	41 F Conus	12	L	1,120 r in 25 d. (× 2 in 0.5 yr.)	Walks well. Does own housework and is asymptomatic.
829865	23 F Conus	9	?	850 r in 30 d. (× 2 in 1.2 yr.)	Seen in 1950. No spinal recurrence. Astrocytoma of cerebellum.
928621	23 M Conus	9	L	1,700 r in 9 d. (1 series)	Walking, legs weak, no pain.
699046	47 F Conus	7	D	1,200 r in 17 d. (× 5 in 5 yr.)	Now deceased (year unknown). No disability after second course of radiotherapy through seven-year follow-up to 1943.
864967	50 F Conus	6	L	850 r in 5 d. (× 4 in 0.5 yr.)	Walking; working as nurse.
17741-H	23 F Filum	5	?	2,100 r in 20 d. (× 3 in 0.5 yr.)	Seen in 1938. Asymptomatic and no physical disability.
864681	25 M Conus	5	L	3,000 r in 30 d. (1 series)	Walks poorly. Bladder control impaired.
974382	39 M Conus	4	L	2,000 r in 16 d. (× 3 in 0.7 yr.)	Asymptomatic. Leads normal life.
997611	42 M Conus	3	L	1,500 r in 17 d. (× 3 in 0.5 yr.)	Walking; working; no pain.
652279	23 M Conus	3	L	1,680 r in 20 d. (× 3 in 2 yr.)	Walks well. Mild urinary bladder disorder.
700605	60 M Conus	2	?	1,100 r in 17 d. (1 series)	Seen in 1943. Initially improved.
747069	48 M Conus	1	?	1,050 r in 13 d. (× 3 in 0.3 yr.)	Seen in 1945. Bedridden and uremic. Presumed dead.
097502	27 M Conus	1	L	3,950 r in 31 d. (1 series)	Walking well. Asymptomatic. Foreign travel.
087923	33 M Filum	1	L	2,375 r in 17 d. (× 2 in 0.5 yr.)	Walking well and working. Asymptomatic.
003593	51 M Conus	0.1	?	2,100 r in 12 d. (1 series)	Seen in 1950. Improved; returned to native Turkey.

* Explanation of certain figures and letters used in Tables V, VI, and VII is necessary. In Column 2, the age given is the age in years at the time the patient was first admitted to the hospital for treatment. Survival in years refers to the documented duration of life after surgical verification of the lesion. L or D indicates whether the patient is known to be living or dead in 1953, and a question mark indicates lack of such information. Column 5 gives a summary of radiation therapy for each patient. The various numbers of *r* refer to the total dose of radiation to the tumor as measured in *roentgens* and were calculated from standard depth dose tables and isodose curves (see text). The time for delivery of the entire tumor dose is given in days. In parentheses is given the number of approximately similar series of treatments administered (including the first series) and the number of years over which repeated treatment was extended.

or irradiation, is inadequately recorded. It is known, to be sure, from the study of neglected cases and unfaithful patients, that the course of untreated spinal tumors is progressive. Eventually they will result in crippling disability and death.

The results of radiation therapy for spinal cord tumors have been reported variously. The reports of Flatau (7) in 1924 and of Marburg and Sgalitzer (11) in 1930 are of interest and indicate an early recognition of the benefits of radio-

TABLE VI: RESULTS OF TREATMENT OF INTRAMEDULLARY TUMORS OF THE SPINAL CORD*

Astrocytoma: Twelve Patients

Unit No.	Age, Sex and Locus	Survival in Years	1953 L or D	Radiation Therapy	Remarks
606872	37 F Lumbar	16	L	1,800 r in 16 d. (× 2 in 4 yr.)	Walks with braces. No progression of disability. No bowel or bladder disorder.
727633	50 M Thoracic	9	L	1,400 r in 12 d. (× 2 in 0.3 yr.)	Wheel chair. No pain. No bowel or bladder disorder.
754533	37 F Cerv.	8	L	1,750 r in 16 d. (× 8 in 5 yr.)	Moderate temporary improvement. Later difficulty in walking, numbness of hands, and neck pain returned. Now bedridden.
563542	45 F Cerv.	7	D	1,950 r in 19 d. (× 8 in 7 yr.)	Marked initial improvement. Recurrent symptoms controlled by repeated series.
824960	40 M Cerv.	6.5	L	1,700 r in 13 d. (× 5 in 3 yr.)	Marked improvement for four years. Now hospitalized.
792910	5 M Conus	6	L	1,700 r in 12 d. (× 5 in 1.5 yr.)	Walks well, attends school, no pain, rare urinary incontinence.
931159	9 F Thoracic	5	L	2,000 r in 11 d. (× 4 in 2 yr.)	Walks well and attends school; scoliosis, weakness right leg, no pain.
009375	55 M Thoracic	4	L	1,840 r in 11 d. (× 2 in 0.3 yr.)	Walks with braces; no progression of disability.
035756	35 M Cerv.	2.5	L	1,850 r in 10 d. (× 3 in 0.4 yr.)	Walks well, working, asymptomatic.
023427	47 F Thoracic	2	L	1,820 r in 10 d. (× 3 in 0.4 yr.)	Walking and working. Mild back and leg pain.
883124	62 F Cerv.	0.3	D	1,600 r in 13 d. (1 series)	Postoperative paraplegia; unimproved before death.
957413	26 F Lumbar	0.1	?	1,700 r in 14 d. (1 series)	Seen in 1949. Moved from city. Moderate improvement after treatment.

* See footnote to Table V.

therapy in the management of spinal gliomas. The majority of the early publications deal with only one or two cases favorably affected by radiation. Long-term follow-up studies are lacking and, unfortunately, a generally accepted histologic classification was not used by the first investigators. Indeed, until the histogenic classification of gliomas was worked out by Bailey and Cushing (1) in 1926, and later applied to spinal lesions by Kernohan, Woltman and Adson (10), in 1931, there was no general usage of pathologic nomenclature, thus inhibiting common understanding of many data for brain tumors as well as spinal cord lesions.

The relative infrequency of intrinsic spinal tumors has made prior reports of questionable value for comparative studies of different methods of treatment. The majority of series have been relatively small, and many authors decline even to attempt evaluation of the importance of radiation therapy in the management of spinal glioma (Shenkin and Alpers, 14; Woods and Pimenta, 18; Woltman, Kernohan, Adson and Craig, 17). The work of Dyke and Davidoff (5) (1942) included a study of only 6 patients with spinal glioma, but these authors foresaw promising results in this field of neuroradiology.

Almost all patients with spinal cord tumor are subjected to surgery for either diagnosis or treatment. Heretofore there has been reluctance on the part of authors to assign definite relative values to surgical treatment and radiation therapy. In the classic study of Woltman *et al.*, a significant number of patients who were treated only by surgery were followed until death. If postoperative deaths are excluded, 34 patients of the Mayo Clinic series can be considered to have died as a result of spinal tumor, its complications, or of intercurrent disease. These 34 patients lived an average of *six years* after operation. For the purpose of attempting to assess the value of postoperative radiation therapy, the present authors have used the data of Woltman *et al.* as a baseline, since there are insufficient cases in our files to determine the prognosis for patients treated by surgery alone.

The present group of 23 patients with ependymoma all received radiotherapy. If all known living patients in whom this

TABLE VII: RESULTS OF TREATMENT OF INTRAMEDULLARY TUMORS OF THE SPINAL CORD*

Unclassified: Twenty-three Patients

Unit No.	Age, Sex and Locus	Survival in Years	1953 L or D	Radiation Therapy	Remarks
715934	38 F Cerv.	16	L	1,080 r in 8 d. (× 15 in 14 yr.)	Walks with supports; does own housework. Urinary frequency. Neurological status stationary.
640848	35 M Thoracic	15	L	1,050 r in 13 d. (× 9 in 4 yr.)	Walks well; works. Vesical sphincter impairment, mild.
754646	37 F Cerv.	9	L	1,840 r in 13 d. (× 7 in 5 yr.)	Walks well; does housework. No sphincter disturbance; no pain.
828575	14 M Thoracic	8	L	1,000 r in 5 d. (× 3 in 0.4 yr.)	Walks without difficulty. Attends school. Asymptomatic.
808403	16 M Cerv.	8	L	1,960 r in 27 d. (× 4 in 1.2 yr.)	Walking, working; under consideration by selective service.
805838	43 M Cerv.	8	L	1,520 r in 18 d. (× 7 in 7 yr.)	Walks without difficulty. Some weakness of legs; clumsiness left hand.
772718	52 M Cerv.	8	L	1,580 r in 16 d. (× 5 in 1.5 yr.)	Improved. Walking limited. No pain or sphincteric disturbance.
779555	48 F Cerv.	7	D	1,550 r in 14 d. (× 2 in 0.8 yr.)	Initial improvement. Later became paraplegic, with pain in the upper extremities.
882844	9 M Thoracic	6	L	1,640 r in 11 d. (× 4 in 0.8 yr.)	Runs and plays normally. No handicap. Asymptomatic.
883040	60 M Cerv.	5	L	1,600 r in 10 d. (× 5 in 1 yr.)	Walks well and works. No pain or disability.
896258	55 F Cerv.	5	L	1,820 r in 10 d. (1 series)	Pain and weakness relieved by single course of radiotherapy. Now bedridden with rectal and vesical sphincter impairment.
019407	23 M Cerv.	4	L	2,210 r in 16 d. (× 3 in 0.7 yr.)	Unimproved. Persistent impaired function of both upper and lower extremities.
045028	58 F Cerv.	2	L	1,700 r in 9 d. (× 2 in 0.3 yr.)	Walks well. Numbness and weakness of upper extremities relieved following radiotherapy.
055542	3 M Thoracic	2	L	2,160 r in 20 d. (× 3 in 1 yr.)	Walks well. Asymptomatic. No neurological deficit.
057081	12 M Cerv.	2	L	2,350 r in 13 d. (1 series)	Walks well; minimal spasticity. Postoperative chest and shoulder pain has not recurred.
030286	68 F Thoracic	2	L	1,700 r in 12 d. (× 5 in 1.5 yr.)	Walks with assistance. Back pain, leg pain, and involuntary movements of legs relieved by radiotherapy.
053068	45 F Cerv.	2	L	2,160 r in 24 d. (× 3 in 1.2 yr.)	Walks well. Striking initial relief of pain in left hand and numbness of right hand. Pain has now recurred.
048379	32 F Cerv.	1.5	?	1,650 r in 18 d. (× 2 in 0.3 yr.)	Seen in 1952. Walking, working; marked improvement in motor and sensory deficits.
066120	62 M Thoracic	1	?	1,750 r in 15 d. (1 series)	Seen in 1952. Moderate relief of chest pain and paresthesias of legs.
569705	35 F Cerv.	1	?	2,400 r in 14 d. (× 2 in 0.2 yr.)	Seen in 1947. Unimproved, hospitalized.
787416	47 F Lumbar	1	?	1,025 r in 13 d. (× 4 in 1 yr.)	Seen in 1946. Initially improved.
847630	54 F Cerv.	1	D	1,330 r in 13 d. (× 2 in 0.2 yr.)	No improvement following two series of treatment.
102613	18 M Conus	1	L	3,640 r in 38 d. (1 series)	Walks well; increased strength in legs; no pain. Urinary incontinence.

* See footnote to Table V.

diagnosis was verified during the last six years (since 1947) are excluded, there are 16 patients available for assessment. Twelve of the 16 (three-fourths) lived longer than the expectancy with surgical treatment alone (Table V). Four patients were lost to follow-up less than six years after operation and must be considered radiation therapy failures. The patient with the longest survival is only partially disabled and is actively employed at this time, nineteen years after surgery and radiation therapy for an ependymoma of the conus medullaris. Seven patients were living in 1953 but had been followed six years or less. All 7 were improved as a result of surgery and radiotherapy, and the majority were at work.

Of 12 patients with astrocytoma who received postoperative radiation therapy, 5 still living are excluded from appraisal of results because surgery was performed since 1947 and there has not yet been an opportunity for more than six years

TABLE VIII: GRADED RESULTS OF RADIATION THERAPY IN THE MANAGEMENT OF 58 PATIENTS WITH VERIFIED INTRINSIC SPINAL CORD TUMOR

	Good	Fair	Poor
Ependymoma	18	3	2
Astrocytoma	9	2	1
Unclassified	16	3	4
All Patients	43	8	7

follow-up study. Five of the remaining 7 were followed for more than six years beyond the time of surgery (Table VI). One patient died four months after operation, and the other, who had been followed only during the immediate postoperative period, could not be located in 1953.

No conclusions can be reached regarding the results of radiation therapy on the clinical course of 4 patients with classified tumors of miscellaneous types because of the small number in the group. Of the 23 patients with unclassified tumors, 10 (living in 1953) have not been followed six years. Eight of the remaining 13 patients lived more than six years following the institution of treatment (Table VII). The majority are improved as a result of simple decompression and radiation therapy. Of the 5 counted as radiation therapy failures, one is known to be dead and 4 have been lost to follow-up less than six years after operation.

If the three groups (ependymoma, astrocytoma, and unclassified) comprising 36 patients suitable for assessment are taken as a whole, it is seen that 25 (more than two-thirds) survived beyond the average of six years assumed for the effect of surgery alone. Eleven of the larger group died or were lost to follow-up less than six years after operation. Twenty-two patients are alive in 1953 but as yet have not been followed for the period of expectancy resulting solely from surgical treatment. Seven patients of the last group have been seen five years after verification of the diagnosis, with the result that, in terms of known five-year survival, there are 32 patients alive of the 43 operated upon prior to 1948.

While longevity is an absolute measurement of the effectiveness of treatment of the patient as a whole, it would be misleading to suggest that radiotherapy is the sole factor in extending the length of life of the patient with spinal cord glioma. Other forms of therapy in modern medical management contribute to prolonged life, *e.g.*, the use of antibiotics to control commonly occurring urinary infections in patients with impaired vesical function. For this reason, it is particularly important to determine whether a true cause-and-effect relationship exists between radiation therapy and improved neurologic function, in addition to relief of pain and extension of longevity. An examination of the clinical records of 58 patients with verified intrinsic spinal cord tumor discloses convincing evidence that, for the majority, the administration of roentgen therapy is followed by the arrest or reversal of neurologic changes (Table VIII). Gratifyingly often, a return of motor and sensory function to normal occurs (see remarks, Tables V, VI, and VII). Excellent results following radiation therapy alone commonly are observed after a tumor recurrence, and in these instances there is no question regarding the possible role of concomitant surgical treatment in the improvement.

COMMENT

The prognosis for patients with tumor of the brain is related more closely to histopathology than any other single factor (Grant, 8). From the present study, this appears to be less true for patients with infiltrating neoplasms of the spinal cord. Almost all intrinsic spinal cord tumors are highly differentiated astrocytomas or ependymomas, which have a long natural course (Bailey, Sosman and Van Dessel, 2). The need for surgical removal of pathologic tissue to predict prognosis, therefore, is not pressing and usually is not performed if there is danger of producing a neurologic deficit. Age and sex of the patient are of minor importance. The location of the lesion is significant in that there is an opportunity to produce greater disability at more cephalic levels. Cervical tumors may not only impair the func-

tion of all four extremities but may disturb diaphragmatic action or even extend into the medulla oblongata.

Individual variation is present in the response of histologically similar tumors to radiation therapy. A strict correlation between the total amount of radiation therapy (or the method of delivery) and the clinical course of individual patients cannot be made. Patients were treated both by multiple short series of roentgen therapy and by a single protracted series of treatments. What constitutes adequate treatment, what is the optimum tumor dosage, and how treatment is most effectively administered are questions still without clear answers.

Pathological studies indicate that a working differential sensitivity exists between glial tumors and normal neural tissue (Warren, 15). Until recent years, the approximate level of radiation damage to normal nervous tissue has not been satisfactorily defined. Since Boden and others established the minimal lethal dose of radiation for neuronal elements, the delivery of tumor doses near nervous tissue tolerance has been attempted more often. Sufficient time has not yet elapsed to evaluate effects of more intensive irradiation in the present group of patients. For this reason, we believe that, for the present, time-proved conservative radiation regimens should be pursued. Excellent results have been obtained with the multiple course method of treatment, in which a tumor dose of 1,500 to 2,000 r is repeated several times, usually coincident with exacerbation of symptoms. We feel that this method of radiation therapy is preferable to intensive treatment, particularly in the tumors located at high spinal levels, in which an attempt to eradicate the neoplasm by radiotherapy may endanger the surrounding normal portions of the spinal cord and increase the chances of irreparable cord damage. The experiences of Davidoff, Dyke, Elsberg and Tarlov (4) and of Hampton, Brick, Amory, Friedman and Lewis (9) in regard to damage of normal nervous tissue do not encourage the use of very intensive radiation therapy for patients with central nervous system tumors.

Despite the failure of radiation therapy to control the new growth in some patients of our present group, a trend continues toward more conservative surgical intervention. The large number of patients with short postoperative periods of observation in the unclassified intramedullary group indicates the more frequent restriction of surgery to decompression by laminectomy and evacuation of neoplastic cysts, and to greater reliance upon roentgen therapy for control of the tumor proper. This method of conservative management is analogous to that proposed earlier by Peirce, Cone, Elvidge and Tye (13) and later by Peirce and Bouchard (12) in the case of brain tumor.

Results which cannot be measured in statistical terms are the palliative effects of roentgen therapy. Moderate to marked temporary regression of the new growth occurs in the majority of patients, even those with more rapidly growing lesions. Treatment should be undertaken with the hope of controlling the neoplastic process permanently. For the majority of the remaining patients, in whom permanent control cannot be accomplished, many months and often years of comfortable and useful existence can be anticipated.

SUMMARY

1. A study of the case histories of 62 patients with verified intrinsic tumors of the spinal cord indicates that the average longevity is greater when immediate postoperative radiation therapy is administered than with surgery alone, regardless of the type of glioma present.

2. Radiation therapy enhances recovery of function following surgical treatment of spinal glioma and usually inhibits advancement of disability if recurrence takes place. Pain is almost always alleviated.

3. Experience has produced a trend to conservative surgery, which usually consists of decompression by laminectomy,

evacuation of areas of cystic degeneration in the case of intramedullary tumors, and removal of easily accessible portions of tumor in the case of lesions of the lumbosacral area. A trend exists, also, toward more intensive radiation therapy, since the tolerance of normal tissue is now better defined, although the value of higher dosage is not yet clear.

4. The conclusion that radiation therapy should be administered to all patients with primary intrinsic spinal cord tumor following surgical verification of the lesion appears justified.

University Hospital
Chapel Hill, N. C.

REFERENCES

1. BAILEY, P., AND CUSHING, H.: A Classification of the Tumors of the Glioma Group on a Histogenetic Basis with a Correlated Study of Prognosis. Philadelphia, J. B. Lippincott Co., 1926, pp. 53–95.

2. BAILEY, P., SOSMAN, M. C., AND VAN DESSEL, A.: Roentgen Therapy of Gliomas of the Brain. Am. J. Roentgenol. **19:** 203–264, March 1928.

3. BODEN, G.: Radiation Myelitis of the Brain-Stem. J. Fac. Radiologists **2:** 79–94, July 1950.

4. DAVIDOFF, L. M., DYKE, C. G., ELSBERG, C. A. AND TARLOV, I. M.: The Effect of Radiation Applied Directly to the Brain and Spinal Cord. I. Experimental Investigations on Macacus rhesus Monkeys. Radiology **31:** 451–463, October 1938.

5. DYKE, C. G., AND DAVIDOFF, L. M.: Roentgen Treatment of Diseases of the Nervous System. Philadelphia, Lea & Febiger, 1942, pp. 156–163.

6. ELSBERG, C. A.: Surgical Diseases of the Spinal Cord, Membranes and Nerve Roots. New York, P. B. Hoeber, Inc., 1941, pp. 208–230.

7. FLATAU, E.: Radiotherapy of Tumors of the Brain and Medulla. Rev. neurol. **31** (Pt. 1): 176–191, February 1924.

8. GRANT, F. C.: Notes on a Series of Brain Tumors. J.A.M.A. **153:** 22–23, Sept. 5, 1953.

9. HAMPTON, A. O., BRICK, I. B., AMORY, H. I., FRIEDMAN, M., AND LEWIS, L. G.: Delayed Effects of Million Volt Irradiation on Normal Tissues and Testicular Tumors. Scientific Exhibit, Fifty-Second Annual Meeting, American Roentgen Ray Soc., Washington, D. C., Sept. 25–28, 1951. Am. J. Roentgenol. **66:** 823, November 1951.

10. KERNOHAN, J. W., WOLTMAN, H. W., AND ADSON, A. W.: Intramedullary Tumors of the Spinal Cord. Review of 51 Cases, with Attempt at Histologic Classification. Arch. Neurol. & Psychiat. **25:** 679–701, April 1931.

11. MARBURG, O., AND SGALITZER, M.: Die Röntgenbehandlung der Nervenkrankheiten. Sonderbande zur Strahlentherapie **15:** 136–146, 1930.

12. PEIRCE, C. B., AND BOUCHARD, J.: Role of Radiation Therapy in the Control of Malignant Neoplasms of the Brain and Brain Stem. Radiology **55:** 337–343, September 1950.

13. PEIRCE, C. B., CONE, W. V., ELVIDGE, A. E., AND TYE, J. G.: Roentgen Therapy of Primary Neoplasms of the Brain and Brain Stem. Preliminary Report of the Four-Year Period Jan. 1, 1939–Dec. 31, 1943, with Follow-Up as of Sept. 1, 1944. Radiology **45:** 247–252, September 1945.

14. SHENKIN, H. A., AND ALPERS, B. J.: Clinical and Pathological Features of Gliomas of the Spinal Cord. Arch. Neurol. & Psychiat. **52:** 87–105, August 1944.

15. WARREN, S.: Effects of Radiation on Normal Tissues. IX. Effects on the Nervous System. Arch. Path. **35:** 127–139, January 1943.

16. WOLF, A.: Tumors of the Spinal Cord, Nerve Roots and Membranes. In: Elsberg, C. A.: Surgical Diseases of the Spinal Cord, Membranes and Nerve Roots. New York, P. B. Hoeber, Inc., 1941, pp. 231–264.

17. WOLTMAN, H. W., KERNOHAN, J. W., ADSON, A. W., AND CRAIG, W. M.: Intramedullary Tumors of Spinal Cord and Gliomas of Intradural Portion of Filum Terminale. Fate of Patients Who Have These Tumors. Arch. Neurol. & Psychiat. **65:** 387–393, March 1951.

18. WOODS, W. W., AND PIMENTA, A. M.: Intramedullary Lesions of Spinal Cord: Study of 68 Consecutive Cases. Arch. Neurol & Psychiat. **52:** 383–399, November 1944.

SUMARIO

El Valor de la Radioterapia en la Asistencia de los Tumores Intrinsecos de la Médula Espinal

Tratando de justipreciar el valor de la roentgenoterapia, se ha repasado una serie de 62 tumores de la médula espinal. Treinta y nueve fueron clasificados histopatológicamente (23 ependimomas, 12 astrocitomas; 2 lipomas; 1 hemangioblastoma; 1 mesenquimoma), y en 23 se estableció el diagnóstico meramente con la inspección macroscópica quirúrgica sin extirpar tejido.

Durante el período preoperatorio inmediato, se administró radioterapia a cada uno de los 62 enfermos. En la mayoría, la cantidad de irradiación entregada en cada sesión fué de 200 r al aire, variando la dosis total y el momento de la entrega. En muchos casos, administráronse series repetidas de irradiación varios meses o años después de la serie primitiva. Los pormenores aparecen en forma de tabla.

Trazóse una comparación entre los resultados obtenidos en esta serie de casos y los de una serie de 34 casos tratados exclusivamente con la cirugía en la Clínica

Mayo, con una sobrevivencia media de seis años consecutivamente a la operación. Para los fines de esa comparación sólo se consideraron los pacientes irradiados a lo menos seis años antes. De 36 de esos enfermos, 25 habían vivido más del período de seis años. A juzgar por dicha comparación, parece que la longevidad media de los enfermos que reciben irradiación postoperatoria es mayor, independientemente de la forma de glioma que exista. La radioterapia acrecienta el restablecimiento de la función consecutivamente a la cirugía y suele inhibir la agravación de la incapacidad, de haber recurrencia. El dolor se alivia casi siempre.

Aunque ha habido una tendencia en pro de una radioterapia más intensa desde que se ha definido mejor la tolerancia del tejido normal, no está todavía en claro el valor de las dosis más altas. Por esta razón, parece que deben seguirse regímenes conservadores. Se han obtenido resultados excelentes con el método de series múltiples, en que se repitió una dosis tumor de 1,500 a 2,000 r varias veces, coincidiendo por lo general con la exacerbación de los síntomas.

DISCUSSION

Carleton B. Peirce, M.D. (Montreal, Quebec): Dr. Wood's and his associates' group of patients with intrinsic spinal cord tumors affords numerically valuable case material in the study of these neoplasms of the central nervous system, which are relatively uncommon save in large centers. It is to be hoped that before too long the several observers who have opportunity to contribute significantly to the statistical compilation of such data will adopt a common and relatively complete formula for record analysis and publication.

Although I agree fully in the recommendation that patients with known, histologically proved intrinsic spinal cord tumors should be given the benefit of radiation therapy, and some others must be considered for palliation without histologic diagnosis, I would hesitate to accept from the most able neurosurgeon a diagnosis based only upon palpation and visual estimate at operation.

The data given are of value in regard to the histologically classified tumors. It should be emphasized that in this series these include only the ependymomas and astrocytomas, whose long natural history the authors have noted.

Although clinical improvement has been suggested, I would prefer more definite information as to (*a*) comparative preoperative signs; (*b*) pre-diagnostic duration of these signs and symptoms; (*c*) critical analysis of motor or sensory functional change in so far as possible following treatment, in assessment of both immediate and late effects not only of the over-all treatment but especially in the detection of possible vascular and glial changes following repeated periodic irradiation.

All radiation therapists are aware of the sensory-depressant effect of irradiation, especially upon the end organs and to perhaps lesser extent on the synapses in the cord and posterior root ganglia. This might be used in cord lesions for assessment of post-irradiation changes in such tumors, as well as motor function.

The predilection of the ependymomas for the conus and the filum terminale is fortunate for the patient, in that the extent of damage by the tumor or by vascular changes which may result from repeated irradiation is limited in extent. This is not so favorable with the astrocytomas (nor the other more rare tumors), which in the essayists' group were of progressively increasing frequency cephalad.

I hope Dr. Wood and his colleagues will persevere in the follow-up of the remainder of their cases and give us the benefit of their subsequent observations at some later date.

With reiteration of my endorsement in principle of irradiation of primary histologically proved intrinsic cord tumors, but a firm caution against repeated, interrupted-series treatment and a strong recommendation of more detailed pre- and post-radiation comparative analyses, I shall leave further discussion of the many points presented in this paper to Dr. Bouchard.

Jean Bouchard, M.D. (Montreal, Quebec): Dr. Wood and his associates deserve congratulations on a valiant attempt to determine the value of external radiation therapy in the management of intramedullary tumors of the spinal cord. I am pleased that they have been able to make this attempt, since we have been unable to do so with our material because of difficulties inherent in the problem. These Dr. Wood has presented, I think, quite nicely in his analysis of the situation.

As we look over this entire problem, it appears to me that we have in the report that has been presented some pretty concrete information as to the place of radiation therapy in two types of tumor of the spinal cord, namely the ependymomas and astrocytomas, and we have follow-up information which is quite valuable. There is

little information available as yet on the role of radiation therapy in the less common spinal cord tumors. It will probably be some time before we get this from the various centers where such tumors are being so treated.

There seems to be, clinically and in other ways, a difference between some types of glioma in the brain and in the cord. In other words, I have a definite impression that, whether we are dealing with an astrocytoma or an ependymoma, its behavior in the brain differs from that in the cord. This I imagine is the result not so much of the histopathologic picture as of mechanical interference with normal function. Thus, tumors of the spinal cord, within the small space available for their growth, produce in proportion to their size more damage to the blood supply and to the normal structures than would similar tumors in the brain. I believe that is probably, also, one of the reasons for difficulty in assessment of our results.

The evaluation of treatment, in my estimation, cannot be made solely or even largely on the basis of survival figures only. Those are important, particularly if you adopt a base line as Dr. Wood and his group have done, starting with the known survival rates in patients who have not been treated or have been treated with surgery alone, but one also has to consider the degree of recovery. I have seen a few patients with tumors of the spinal cord who have been treated with fairly adequate dosage and are still enjoying relatively long survivals but have not felt any objective improvement in their condition. These are cases in which there was probably already too much damage to the normal structures from the tumor prior to the application of any form of treatment.

The problem of dose and distribution in time is important. Again we don't know what is the better level of dosage. In our own group, for the majority of spinal cord tumors a minimum of 3,500 to 4,000 r tumor dose spread over a period of forty, forty-five, or sometimes fifty days, seems to give good results, and we doubt if such dosage level can be exceeded safely.

In closing I would like to say a few words on the danger of excessive dosage with our high-energy sources of radiation, which are becoming more easily available. I think with these there is probably more danger of damage to the spinal cord than with x-radiation at the conventional deep-therapy level. Dr. Harvey mentioned this in his excellent Carman Lecture.

In conclusion, I would like to say that Dr. Wood and his associates certainly have demonstrated the unquestionable value of radiation therapy in the management of tumors of the spinal cord and that this is, in my estimation, the best presentation of the current status of radiation therapy in the management of these tumors.

Dr. Wood (*closing*): I would like to thank Dr. Peirce and Dr. Bouchard for their kind remarks and thought-provoking comments in discussing this paper.

Approximately three years ago I was asked to give a comprehensive discussion of radiation therapy of nervous system tumors. It was at that time that I realized the paucity of information that was available regarding the roentgen treatment of primary spinal cord neoplasms. An outstanding report on intrinsic spinal cord tumors to which I have referred, *viz.*, that of Woltman, Kernohan, Adson and Craig, gives no assessment of the value of roentgen therapy, although a number of patients were treated. It is for the purpose of making known that radiation therapy is of value to patients with intramedullary spinal cord tumors that we have reported our results.

We, too, hope that in a few years the answers to many of the questions raised by Doctors Peirce and Bouchard will be more evident.

Skin Dose from a Cobalt 60 Teletherapy Unit[1]

JASPER E. RICHARDSON, Ph.D.,[2] HERBERT D. KERMAN, M.D.,[3] and MARSHALL BRUCER, M.D.

BECAUSE OF ITS physical characteristics, high-energy radiation offers several advantages over radiation of lower energy in the treatment of deep-seated tumors. These are: (*a*) an increase in percentage depth dose, (*b*) a decrease in side-scatter, resulting in flatter isodose curves with a smaller penumbra, and (*c*) the establishment of electronic equilibrium at a greater depth, resulting in a smaller skin dose. With the Co^{60} unit under test at this laboratory, it was found that little could be done to affect (*a*) or (*b*), with the exception of a moderate dependence of penumbra on cone design. For short cone-to-skin distances, the third advantage is greatly affected by electrons scattered from the walls of the collimating system. This report is a study of the electron build-up region and the optimum cone design necessary to preserve the third advantage.

When gamma rays enter tissue, they lose energy through interactions, and accelerated electrons are produced. These electrons in turn lose their energy as they penetrate tissue by radiation processes or by removing other electrons from their atoms (ionization). If the initial electron acquires a high energy from the gamma ray, thousands of electrons and positive ions are produced by this one electron along its path, since only a small amount of energy (about 32.5 ev) is lost in producing each ion pair. The accelerated electrons penetrate the tissue to an average depth corresponding to the energies given the electrons by the gamma rays.

If the beam of gamma rays is completely free of electrons before entering the tissue and if there are no back-scattered gamma rays or electrons, the ionization at the surface will be zero. When the gamma rays enter the tissue, accelerated electrons are produced, and at Co^{60} energies the acceleration is predominantly in a forward direction. As the tissue is penetrated, additional electrons are accelerated with each increment of depth. Thus the number of electrons, and consequently the ionization, builds up with depth. This build-up progresses until a depth corresponding to the average range of the electrons is reached. At this depth, equilibrium has been established between the primary and secondary radiation, and the maximum number of electrons that can contribute to the dosage has been achieved. Beyond this depth, the number of gamma rays per unit area decreases due to the divergence of the beam and to interactions in the preceding layers of tissue. Hence, with further increase in depth, the ionization decreases relatively slowly.

There are two other sources of radiation usually present which add to the ionization in the electron build-up region. The first is back-scattered gamma rays which produce additional ionization at all depths up to and including the surface. The second is electrons (from the collimating system or from air) that contaminate the gamma-ray beam.

Several workers have studied the phenomenon of electron build-up. Among those working with x-ray generators, Trump and Cloud (9) studied the effect of energy, treatment distance, filtration, and field size. Miller (6) studied the effect of the limiting diaphragm-skin distance, field size, and distance from the center of the field. Johns *et al.* (5), using a Co^{60} unit, studied the effect of cone-to-skin distance and field size. Although for the same energy source the results should be similar, the actual measurements will vary with the design of the unit and the range of cone-to-skin dis-

[1] From the Medical Division of the Oak Ridge Institute of Nuclear Studies, Inc., Oak Ridge, Tenn., under contract with the United States Atomic Energy Commission. Accepted for publication in August 1953.

[2] Assistant Physicist, M. D. Anderson Hospital, Houston, Texas.
[3] Department of Radiology, University of Louisville, Louisville, Ky.

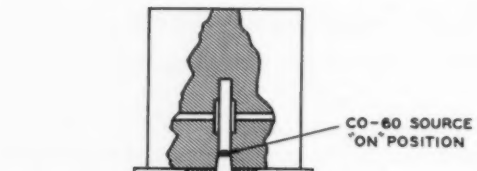

Fig. 1. Cut-away view of cobalt 60 teletherapy unit showing the collimating system.

tances, since these, in part, determine the amount of electron contamination present in the beam.

DESCRIPTION OF COLLIMATING SYSTEM

The unit used in these measurements is illustrated in Figure 1 and has been described elsewhere (3). Only the features of the collimating system will be reviewed here.

The collimating cone is made of lead and has a 1/16-inch steel inner lining. Any electrons from this cone will be those produced in the steel lining, since its thickness (1.5 mm.) is adequate to stop the highest energy electrons produced in the lead by the cobalt gamma rays. With a treatment cone following the taper of the collimating cone, the largest field obtainable from the unit at 50 cm. source-to-skin distance (S.S.D.) is 15 × 15 cm.

The lead treatment cones, or field limiting portals, determine the size of the field. These cones are of interchangeable sizes. They extend 10 cm. beyond the lower extremity of the collimating cone, giving a cone-to-skin distance of 4 cm. at 50 cm. S.S.D.

Electrons from the source are certainly not present in the beam. Such electrons have insufficient energy to penetrate the 0.5-mm. steel window of the source box. In addition, they would have to penetrate a thin aluminum contamination seal and the mirror of the light localizer.

EXPERIMENTAL ARRANGEMENT

Three treatment cones were used in the study. The first was an untapered, experimental lead cone, the inner diameter of which could be made either 2 cm., 5 cm., or 10 cm. by the use of close fitting lead plugs. The other two were tapered lead treatment cones with brass inner linings, designed to give fields of 4 × 6 cm. and 10 × 10 cm. respectively at 50 cm. S.S.D. Extensions were made to fit the tapered cones so that measurements could be made for their field sizes at 50 cm. S.S.D. with either 0 cm. or 4 cm. cone-to-skin distances. As the actual dimensions of the cones were so near those of their respective fields at 50 cm. S.S.D., the designation 2 cm.-diameter, 4 × 6-cm., or 10 × 10-cm. cone, will be made when referring to the cone used for a particular set of measurements.

The relative ionization can change rapidly over a small increment of depth in the electron build-up region. It is therefore important that the air volume of the ionization chamber be as shallow as possible. Measurements were made with an ionization chamber similar to that used by Trump and Cloud (9) and by Miller (6). Its active volume was 2 cm. in diameter by 1 mm. deep. The chamber was covered by a 0.03-mm. sheet of Polystyrene with an Aquadag coating on its under surface. Thus 0.03 mm. was the minimum "tissue" depth measurable. The ionization chamber was embedded in a 1-cubic foot Masonite phantom (Fig. 2) to include the 3 to 5 per cent back-scatter in the measurements and to enable movement from the center to the edge of the field by means of an adjustment attached to the phantom.

The current was measured by means of a vacuum tube electrometer bridge circuit designed by T. E. Bortner (1), Oak Ridge National Laboratory. The lead box containing the electrometer tube and a 10^{10} ohm resistor was connected to the chamber by an aluminum wire passing through a ceresin-filled aluminum tube 15 cm. in length.

Lucite and Polystyrene of various thicknesses were placed over the ionization chamber in the path of the beam to represent thicknesses of skin. Since the density of Polystyrene was nearest unity, 1.02 gm./c.c., all Lucite absorber thicknesses were converted to equivalent thicknesses of Polystyrene by the ratio of densities. The interaction of Co^{60} gamma rays with this material is primarily Compton scattering, which is relatively independent of the atomic number.

Since the ionization chamber had a shallow air volume and a body of depth comparable to that of the electron build-up region, a fixed polarity chamber voltage was not used. The ionization for any absorber thickness was taken as the average of the two currents measured with positive and negative voltages applied to the window of the chamber. The ionization measured with a single polarity of voltage is not the true ionization within the active volume of the chamber because of a characteristic of chambers of this design (8).

Fig. 2. Photograph of parallel plate ionization chamber and Masonite phantom.

PROCEDURE

The distribution of ionization in the first centimeter of tissue-like material was determined for a variety of conditions. The active volume of the ionization chamber was always located at the center of the field. These measurements were intended to simulate ionization in tissue with the tissue surface located at a fixed distance from the source of radiation. However, except for zero cone-to-skin distance, the ionization chamber was at a fixed distance while the absorber surface moved closer to the source with increasing thickness. As required, small inverse-square corrections were made to allow for the slight decrease in S.S.D. when an absorber was placed on the chamber. The effect of the movement of the absorber surface into the cloud of electrons could best be determined experimentally. It was found that the inverse-square corrections sufficed for both electrons and gamma rays to within the accuracy of the measurements. This was probably due to the fact that the low-energy electrons scattered at large angles in air were removed from the beam by the first few absorbers, where the decrease in S.S.D. was very small. With thick absorbers, only the higher-energy electrons scattered in a more forward direction were detected, and these were comparatively less sensitive to distance.

CONDITIONS OF MEASUREMENT

A. The first measurements were made to determine the effect of the inner lining of the treatment cone, with the untapered, experimental cone. Other than the lead from which the cone was constructed, two additional linings were chosen: brass and Lucite. Interchangeable brass and Lucite tubes were made to fit tightly inside the lead cone. Although the diameter of the cone was slightly smaller with the linings in place, the thicknesses of the linings were too small, as compared to the diameter

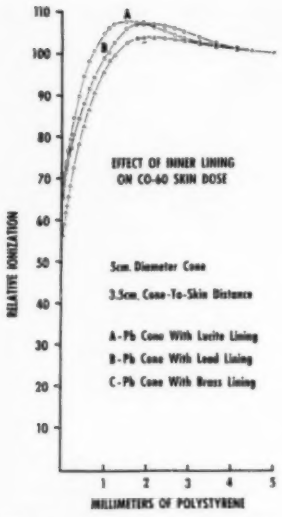

Fig. 3. Graph showing the effect of inner lining on skin dose.

of the cone, to have appreciably reduced the field size.

B. The effect of cone-to-skin distance was determined with use of the two brass-lined cones. In this series of measurements, the two field areas were not held constant, except for 0 cm. and 4 cm. cone-to-skin distance, but increased with S.S.D.

C. The effect of field size was next determined for two cone-to-skin distances: 4 cm. and 34 cm. Three cones were used, giving fields of 2 cm. diameter, 4 × 6 cm., and 10 × 10 cm., respectively, at 50 cm. S.S.D.

D. For a fixed cone-to-skin distance, the effect of filters was studied. Several readily available materials covering a wide range of atomic numbers were used.

E. One of the filter materials (cadmium) was chosen, and the effectiveness

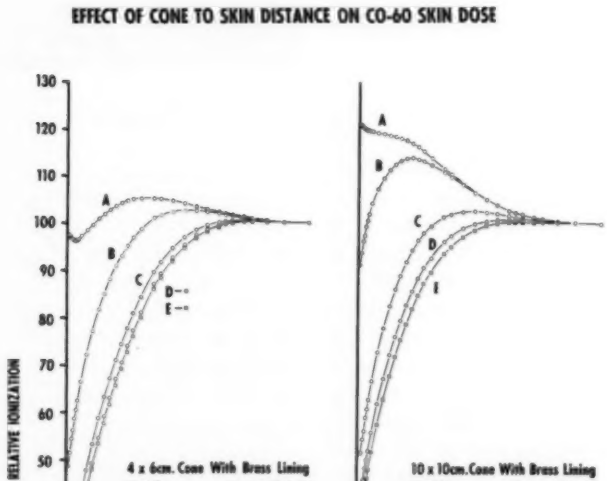

Fig. 4. Graph showing the effect of cone-to-skin distance on skin dose.

of this filter in reducing the "no-filter" skin dose was determined at different cone-to-skin distances.

For measurements taken with the same cone and at a fixed cone-to-skin distance, no differences in relative ionization were observable for absorber thicknesses greater with points falling within 0.5 per cent of the values given here.

EXPERIMENTAL RESULTS

A. Effect of Inner Lining: The dose distribution in the first 5 mm. of tissue-like material is shown in Figure 3 for a 5-cm.-

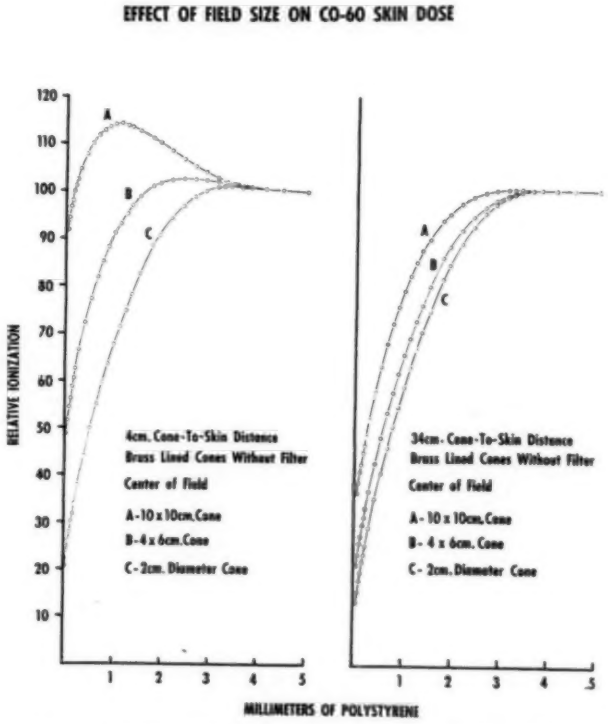

Fig. 5. Graph showing the effect of field size on skin dose.

than 5 mm. Polystyrene, regardless of the filter or lining used.

All curves obtained under the same geometrical conditions were normalized together, using relative ionizations corresponding to absorber thicknesses between 6 mm. and 10 mm. Polystyrene. The average of these curves was then arbitrarily normalized to 100 per cent at 5 mm. absorber thickness. Since there were no differences beyond this thickness, the curves presented were plotted only up to 5 mm. It was found that, after a complete change in geometry, curves could be reproduced

diameter cone with three different inner linings. One of these linings was of low atomic number (Lucite), one of intermediate atomic number (brass), and one of high atomic number (lead). Similar linings in a 10 cm. diameter cone showed the same relative effects with increased ionization throughout the build-up region. As was expected, the material of intermediate atomic number, brass, gave the most satisfactory results.

B. Effect of Cone-to-Skin Distance: With the two brass-lined cones, measurements were made at cone-to-skin distances

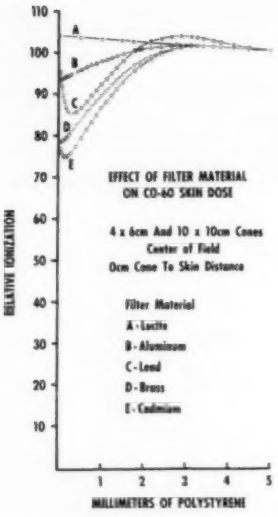

Fig. 6. Graph showing the effect of filter material on skin dose.

of 0, 4, 14, 24, and 34 cm. The results are shown in Figure 4. At 50 cm. S.S.D., 0 cm. and 4 cm. cone-to-skin distances, the field areas were 24 sq. cm. and 100 sq. cm. respectively. For the other three cone-to-skin distances both field areas were greater by the factors 1.4, 2.0, and 2.6.

C. Effect of Field Size: The effect of field size for two cone-to-skin distances, 4 cm. and 34 cm., is shown in Figure 5 for three cones with field areas in the ratio 1, 8, and 32. The 34 cm. distance was chosen, since this was the approximate distance at which the relative surface ionization reached its minimum value.

D. Effect of Filter Materials: Different materials and different thicknesses of the same material were tried as "electron" filters to determine their effect on the distribution of ionization. It was found that above a certain thickness any further increase in thickness of a given filter material had no effect other than in the attenuation of the primary gamma ray beam. All filters were of this optimum thickness, or greater, and were mounted over the lower end of the treatment cone.

The effect of the atomic number on the distribution of ionization in the electron build-up region is shown in Figure 6, with various filter materials "in contact" with the absorbers, simulating contact treatment.

The effect of increasing the cone-to-skin distance from 0 cm. to 4 cm. is shown in Figure 7 for two cones with several filter materials. Since the geometrical penumbra 4 cm. from the cones was only 2 mm., the field areas for either cone were essentially the same at both cone-to-skin distances.

E. Effect of Cadmium Filter with Increasing Cone-to-Skin Distance: The effectiveness of the filter in reducing the skin dose was determined at different cone-to-skin distances. The distributions of ionization with and without a cadmium filter are shown in Figure 8 for cone-to-skin distances of 0, 4, 14, 24, and 34 cm.

DISCUSSION OF RESULTS

A. Effect of Inner Lining: When a beam of gamma rays is incident upon a material whose thickness is of the order of, or greater than, the range of the secondary electrons produced in the material, the emission of electrons in the forward direction is found to vary with the atomic number of the material. Quimby, Marinelli, and Blady (7), as well as others, studied this phenomenon using radium as the source. Wilson and Perry (10) studied the effect using a 1 and 2 mev x-ray generator. Hine (4) made use of radioactive isotopes covering a wide range of energies. In all studies it was found that the number of electrons emitted from a material in the forward direction decreased with increase in atomic number up to some intermediate atomic number and then increased with further increase in atomic number. For radium gamma rays the minimum occurred at $Z \sim 40$. For sources of higher energies than radium, the atomic number at which the minimum occurs was found to be slightly higher than that for radium, and for lower energies slightly lower (4). Brass was not far from the minimum and, because of its availability, has been generally used for applicators in radium therapy.

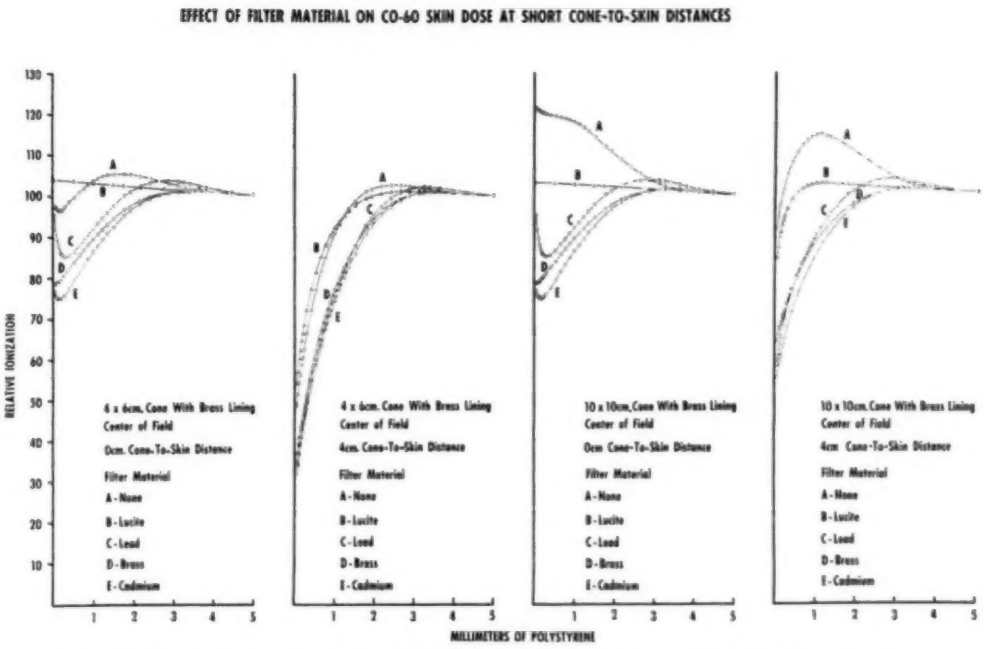
EFFECT OF FILTER MATERIAL ON CO-60 SKIN DOSE AT SHORT CONE-TO-SKIN DISTANCES
RELATIVE IONIZATION
MILLIMETERS OF POLYSTYRENE
4 x 6cm. Cone With Brass Lining
Center of Field
0cm. Cone-To-Skin Distance
4 x 6cm. Cone With Brass Lining
Center of Field
4cm. Cone-To-Skin Distance
10 x 10cm. Cone With Brass Lining
Center of Field
0cm Cone-To-Skin Distance
10 x 10cm. Cone With Brass Lining
Center of Field
4cm Cone-To-Skin Distance
Filter Material
A - None
B - Lucite
C - Lead
D - Brass
E - Cadmium

Fig. 7. Graph showing the effect of filter material on skin dose at short cone-to-skin distances.

The Lucite and lead linings were tried to determine the importance of the atomic number for this particular use. Since the results confirmed the superiority of brass, all later cones were made with brass linings.

B. Effect of Cone-to-Skin Distance: As the cone-to-skin distance increases, the electrons originating in the collimating system are scattered in air and their contribution to the skin dose decreases rapidly. Conversely, with the same increase in distance, the volume of air intercepted by the gamma ray beam increases and more electrons originating in this air volume reach the skin. At the greatest distance for which measurements were made, the contribution of electrons from the collimating system was still decreasing at a greater rate than the contribution of electrons from air interactions was increasing, although the latter was beginning to become significant. At still greater distances, the electrons from air interactions would eventually preponderate. This would occur sooner and be more pronounced for the smaller fields (5).

If the field area had been held constant in these measurements, instead of increasing with S.S.D., it would have necessitated reducing the cone size for each increase in S.S.D. If this had been done, the decrease in relative ionization with increase in distance would have been slightly greater than shown, since a decrease in cone size decreases both the number of electrons originating in the collimating system and in air.

C. Effect of Field Size: Close to the cone, the electrons contaminating the beam are primarily those from the collimating system, and the effect of field size is large. Far from the cone, the electrons are primarily those resulting from air interactions. Since air interactions are few compared to cone interactions, field size has comparatively less effect on the skin dose at great distances.

It should be pointed out that, while the normalization of all curves to 100 per cent at 5 mm. depth indicates that treatment at 80 cm. S.S.D. (34 cm. cone-to-skin distance) would result in relative skin doses

Fig. 18. Graph showing the effect of cadmium filter on skin dose at different cone-to-skin distances.

as shown in Figure 5, this is not necessarily so. If the curves were normalized at 10 cm. depth, the curve for the large cone would read 90 per cent at 5 mm. depth, the intermediate cone 100 per cent, and the small cone 110 per cent. This is due to the increase in percentage depth dose with area of field.

D. Effect of Filter Materials: Flint and Wilson (2) have mentioned using copper as a secondary filter on a radium unit with a short source-to-skin distance. They observed a marked decrease in the effect of secondary radiation on skin dose. Wilson and Perry (10) suggested the possibility of using intermediate atomic number filters with supervoltage x-ray units. Lucite, aluminum, brass, cadmium, and lead were used in the present study. Brass was chosen instead of copper, since it was more readily available. The brass used was a copper-zinc alloy and should therefore give essentially the same results as copper.

Brass filters were tried over the top, half way down, and over the end of the treatment cone in an attempt to avoid electrons from the filter while reducing the effect of electrons from the cone. Although this showed a large share of the electrons to come from the collimating cone, the best results were obtained with the filters over the lower end of the treatment cone. All measurements were made with filters in this position. Brass, cadmium, and lead filters varying in thickness from 0.05 to 1 mm. were tried. When corrected for attenuation of the primary beam, identical results were obtained for filter thicknesses greater than 0.25 mm. Filters of this thickness attenuate the primary cobalt beam by about 2 per cent. Since the electrons from the collimating system showed no effect beyond 5 mm. Polystyrene absorber thickness, the Lucite filter for contact measurements was taken as this equivalent thickness. At 4 cm. cone-to-skin distance, no difference was observed between 3-mm. and 4-mm. Lucite filters. The thickness of aluminum was calculated to be a little greater than that needed to stop 1.2-mev electrons.

The curves shown in Figure 6 are results obtained with the filter "in contact" with the absorber. Due to the nature of the experimental arrangement, it was difficult to tell the exact distance from the filter to the absorber, although it was known to have been within 1 mm.

Of all curves shown in Figure 6, that with a lead filter should have been most critical with distance, as others have found by extrapolation measurements (7). In order to have an estimate of the error, the distance between the lead filter and the ionization chamber was increased by 1 mm. At this distance the relative ionization with 0.03 mm. Polystyrene (no absorber over the window) measured 2 per cent lower than is shown in Figure 6. With 0.5 mm. absorber thickness, the relative ionization was 0.5 per cent lower than shown. There was no change in relative ionization beyond this absorber thickness. The doubtful value is that for 0.03 mm. Polystyrene, which would likely be over 100 per cent if perfect contact were made with an extrapolation chamber.

The relative surface ionizations for aluminum and brass filters are in close agreement with results obtained by Quimby *et al.* (7) using radium. An accurate comparison with the value expected from their results cannot be made for lead, since the curve shown in Figure 6 is almost vertical and has an increasing slope as the zero absorber point is approached. Accurate extrapolation of the curve to zero absorber thickness is thus impossible. The relative surface ionization measurements with the filter in contact should be taken only as a close approximation, since absolute measurements would require the use of the filter material as one electrode of an extrapolation chamber. However, as was found by moving the lead filter 1 mm. farther from the ionization chamber, small changes in geometry have an appreciable effect only on the surface values of the dose distributions. The values obtained by Quimby *et al.* with radium for 0.5 and 1.1 mm. absorber thicknesses show no agreement with the present results for

cobalt. The lack of agreement could be expected because of differences in geometry and energy of the sources.

The curves shown in Figure 6 represent measurements made with both the 4 × 6-cm. and 10 × 10-cm. cones plus extensions. Increasing the field area had no effect on the results. Since the diagonal path of an electron traveling from the edge of the 4 × 6-cm. cone to the active volume was greater than the range of the electron, this electron would not be detected. Any further increase in the area of the field should therefore have no effect other than a slight increase in back-scattered radiation from the Masonite phantom. The increase in back-scattered radiation was apparently small as compared with the ionization due to the electrons.

There is little difference between the shapes of the brass, cadmium, and lead curves beyond 0.25 mm. of Polystyrene other than the maximum in the lead curve, which is believed to be due to photoelectrons from the lower surface of the filter. Between 0 mm. and 0.25 mm. the curves show a definite trend in change of shape with increase in atomic number. An initial decrease in relative ionization indicates that electrons are being absorbed from the beam to a greater extent than electrons are being added to the beam through gamma ray interactions with the absorber. When the latter preponderates, the relative ionization begins to increase. One might take the results of Figure 6 to indicate that, as the atomic number of the filter increases, there is an increase in the number of low-energy electrons leaving the filter in a direction normal to its surface. This was not found to be so.

With the 2-cm.-diameter cone, whose field diameter is the same as that of the active volume, no initial decrease in relative ionization occurred. The measurements agreed with those obtained with the large cones for absorber thicknesses down to about 0.5 mm. and then followed the extrapolation of the curves to zero absorber thickness. This would mean that the electrons in question are coming from areas of the filter other than that area directly over the active volume of the ionization chamber.

The difference in the shapes of the curves near the surface is due to the difference in the angular distributions of electrons. The photoelectric effect accounts for about one-third of the interactions of cobalt gamma rays with lead, and these electrons are accelerated at large angles to the direction of the gamma-ray beam. Also, with a high atomic number filter, the increase in multiple scattering of electrons within the material results in more electrons being emitted at large angles. Therefore, the electrons from the lead filter are less concentrated in the forward direction than are those from low atomic number materials. Electrons emitted at large angles have a diagonal path through the absorber, which is much greater than the thickness of the absorber, and thus are easily absorbed from the beam. If one were to use a lead filter in contact with the skin and find the large dose near the surface objectionable, this surface dose could be reduced by use of a composite filter consisting of a thin sheet of Lucite between the lead and the skin. However, the dose at any "tissue" depth beyond 0.25 mm. would then be increased, since the absorber thickness scale of Figure 6 would be shifted to the right by an amount corresponding to the thickness of the Lucite.

When the cone-to-skin distance is increased to 4 cm., the difference in the angular distributions of the electrons makes the choice of filter material of small importance if one avoids low atomic number materials such as Lucite. In fact, the relative ionization with a lead filter on the 4 × 6-cm. cone is lower than that with a brass filter for absorber thicknesses between 0.1 and 1.5 mm.

Complete measurements at cone-to-skin distances of 14 cm. or greater were not made for any filter material other than cadmium, although spot measurements were made with the other materials at 14 cm. At this distance, curves for the 4 × 6-cm. cone remain in order but fall closer

together. For the 10 × 10-cm. cone, the curves are similar to those for the 4 × 6-cm. cone at 4 cm. cone-to-skin distance.

E. Effect of Cadmium Filter with Increasing Cone-to-Skin Distance: The results show that the cadmium filter is needed only for short cone-to-skin distances. For large distances, the scattering and absorption of electrons in air are sufficient. At a distance of 14 cm., little is gained by use of a filter with the 4 × 6-cm. cone, although, with the 10 × 10-cm. cone, the filter still shows significant improvement at this distance. At 24 cm., the practicability of using a filter on the 10 × 10-cm. cone becomes questionable. Although measurements were made with only two cone sizes, if cones of intermediate sizes were used, one could expect intermediate results.

A greater difference between the "filter" and "no-filter" curves would have been obtained if the cones had not been lined with brass. In one measurement with the 10 × 10-cm. cone in skin contact with no filter, removing the brass lining from the extension caused the relative surface ionization to increase 8 per cent. This represented a small part of the 20 cm. length of the cone. If a filter is used, the brass lining is not necessary.

It should also be mentioned that these filters serve primarily as electron filters. If a significant number of degraded gamma rays were present in the beam, they should be observed at depths greater than 5 mm. When plotting isodose curves in a water phantom, however, it was found that the central axis percentage depth dose as well as the shapes of the isodose curves remained unchanged when a filter was added. Because of their comparatively low linear ion density, the contribution of degraded gamma rays to the total ionization at any given depth was too small to be detected.

Erythema studies were made with rabbits in contact with the cone. Although all rabbits showed both the brass lining and the cadmium filter to be beneficial, the results could not be taken as conclusive because of the small number of animals used.

SUMMARY AND CONCLUSIONS

The skin dose from a cobalt 60 teletherapy unit has been studied for different conditions of irradiation. For short cone-to-skin distances, electrons from the collimating system contaminate the beam and result in an appreciable skin dose. This can be reduced by proper design of the treatment cone. The expectations that a material of intermediate atomic number would prove superior as an inner lining and as a filter to remove secondary radiation were confirmed. However, due to differences in the angular distribution of electrons from the materials, the choice of the material used as an electron filter is not too critical except for contact treatment.

For cone-to-skin distances greater than 20 cm., an electron filter is not needed. Between 4 cm. and 20 cm. cone-to-skin distance, the skin dose is reduced appreciably if an electron filter is used. At these distances, both intermediate and high Z materials were found to be superior to those of low atomic number, although there was little difference between the results obtained with filters of intermediate and high Z materials. For cone-to-skin distances between 0 cm. and 4 cm., optimum results were obtained with a filter material of intermediate atomic number. The difference between intermediate and high Z materials was most significant at 0 cm. cone-to-skin distance.

ACKNOWLEDGMENTS: The authors wish to express their appreciation to the following members of the Oak Ridge Institute of Nuclear Studies: James H. Wilde and Harry E. Kimble for help in the design and construction of the equipment used; William R. Buher and William C. Martin for their participation in the measurements; Nathaniel W. Hill for suggestions in the manuscript.

Physics Department
M. D. Anderson Hospital
Houston, Texas

REFERENCES

1. BORTNER, T. E.: Personal communication.
2. FLINT, H. T., AND WILSON, C. W.: The Measurement of the Dosage and Intensity Distribution in the Radium Teletherapy Unit at Westminster Hospital. Brit. J. Radiol. 8: 426–438, July 1935.
3. GRIMMETT, L. G., KERMAN, H. D., BRUCER, M., FLETCHER, G. H., AND RICHARDSON, J. E.: Design

and Construction of a Multicurie Cobalt Teletherapy Unit. A Preliminary Report. Radiology **59:** 19–29, July 1952.

4. HINE, G. J.: Scattering of Secondary Electrons Produced by γ-Rays in Materials of Various Atomic Numbers. Phys. Rev. **82:** 755–756, June 1951.

5. JOHNS, H. E., CORMACK, D. V., AND FEDORUK, S. O.: Depth Dose Data and Diaphragm Design for the Saskatchewan 1,000 Curie Cobalt Unit. Brit. J. Radiol. **25:** 302–308, June 1952.

6. MILLER, H.: A 2 MeV X-Ray Generator for Therapy. Brit. J. Radiol. **23:** 731–739, December 1950.

7. QUIMBY, E. H., MARINELLI, L. D., AND BLADY, J. V.: Secondary Filters in Radium Therapy. Am. J. Roentgenol. **41:** 804–818, May 1939.

8. RICHARDSON, J. E.: Effect of Chamber Voltage on Electron Build-up Measurements. Radiology **62:** 584–588, April 1954.

9. TRUMP, J. G., AND CLOUD, R. W.: The Production and Characteristics of 3,000 Kilovolt Roentgen Rays. Am. J. Roentgenol. **49:** 531–535, April 1943.

10. WILSON, C. W., AND PERRY, B. J.: Secondary Electron Emission Generated by 1 MeV and 2 MeV X-rays. Brit. J. Radiol. **24:** 293, May 1951.

SUMARIO

La Dosis Piel Procedente de un Aparato de Teleterapia de Cobalto-60

Se ha estudiado en distintas condiciones de irradiación la dosis en la piel procedente de un aparato de teleterapia de cobalto^{60}. En las distancias cono-a-piel cortas, los electrones derivados del sistema colimador contaminan el haz y dan por resultado una dosis cutánea apreciable. Esta puede reducirse con un diseño apropiado del cono de terapéutica. Se han cumplido las esperanzas de que un material de número atómico intermedio resultaría superior como revestimiento interior y como filtro para eliminar la irradiación secundaria. Sin embargo, debido a las diferencias en la distribución angular de los electrones procedentes de las varias substancias, la elección de la substancia usada como filtro de los electrones no es demasiado seria, excepto en el tratamiento por contacto.

Para distancias cono-a-piel mayores de 20 cm., no se necesita un filtro de electrones. En las distancias cono-a-piel de 4 a 20 cm., la dosis en la piel se reduce considerablemente si se usa un filtro de electrones. A esas distancias, las substancias de números atómicos tanto intermedios como altos resultaron superiores a las de números atómicos bajos, aunque hubo poca diferencia en los resultados obtenidos con filtros hechos de substancias de números atómicos ya intermedios o altos. En las distancias cono-a-piel entre 0 y 4 cm., se obtuvieron resultados óptimos con un filtro hecho de una substancia de número atómico intermedio. La diferencia entre las substancias de números atómicos intermedios y altos fué notable a una distancia cono-a-piel de 0 cm.

Improved Control of Advanced Oral Cancer with Massive Roentgen Therapy[1]

GEORGE WHITE, M.D.,[2] JAMES SIENIEWICZ, M.D.[2]
Boston, Mass.
and
WILLIAM R. CHRISTENSEN, M.D.[3]
Salt Lake City, Utah

THE CANCERS of the mouth covered by the title of this paper comprise extensive local lesions and those which have spread from the original site to involve contiguous structures. One hundred and thirty-seven patients with such cancers were treated at Pondville Hospital between 1944 and 1951. This small number precludes any statistical subdivision as to site and we have therefore massed all cases in one main group, intra-oral carcinoma. The primary sites were the tongue, floor of the mouth, tonsillar fossa, buccal mucosa, and palate (Table I). Inoperability was usually due to the location and extent of the disease, though there were a few instances of systemic contraindications to surgery. Some of the patients more recently seen were eligible for radical surgical procedures, but roentgen therapy was elected as the treatment of choice. Most of the patients were in the advanced age group (Table II).

PONDVILLE HOSPITAL 1944-1951
ADVANCED INTRAORAL CANCER
PRIMARY SITES - 137 PATIENTS

	Conventional Therapy	Massive Therapy
FLOOR OF MOUTH	9	25
TONGUE	16	16
TONSILLAR FOSSA	13	23
PALATE	5	1
BUCCAL MUCOSA	11	18
TOTAL (137)	54	83

TABLE I

Prior to 1946, the results following roentgen therapy of intra-oral carcinoma at Pondville Hospital were disappointing. Treatment consisted mainly of external roentgen therapy in the conventional range of 6,000 r tumor dosage. The primary disease was controlled in only 6 out of 54 patients during the period 1944–46. This failure of primary control precluded any attack on metastatic neck nodes and resulted in poor salvage of these patients. Only 1 patient of this group of 54 was alive and well at three years.

PONDVILLE HOSPITAL 1944-1951
ADVANCED INTRAORAL CANCER
AGE DISTRIBUTION

UNDER 50	8
50-59	19
60-69	46
70-79	47
80 AND OVER	17
TOTAL NO. PATIENTS	137

TABLE II

Intra-oral cancer, even though advanced, presents a therapeutic challenge, since the disease frequently remains local and regional for a long time. Metastatic neck nodes are often amenable to treatment in spite of the advanced state of the primary lesion. Their early treatment, however,

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[2] Visiting Radiologist, Pondville Hospital; Instructor in Radiology, Tufts College Medical School.
[3] Former Resident in Radiology, Pondville Hospital.

TUMOR DOSE DISTRIBUTION

137 PATIENTS

TUMOR DOSE (r)		NO. OF PATIENTS
LESS THAN 5,000	Conventional	28
5,000 - 5,900		16
6,000 - 6,900		10
7,000 - 8,900	Massive	33
9,000 - 10,900		38
11,000 AND OVER		12

TABLE III

usually must await a reasonable assurance that the primary cancer has been eradicated. We therefore directed our initial attack toward the disease in the mouth, seeking some means of accomplishing prompt control.

The change in treatment instituted in 1947 involved two factors: (1) a massive tumor dose in order to affect all relatively radioresistant cancers; (2) the use of an intra-oral cone as the keystone of the treatment structure, plus multiple external portals.

In order to improve the results, we felt that a much higher tumor dose would be necessary than the conventional 6,000 r. We decided, therefore, to go as high as 12,000 r and to modify this figure whenever necessary. In this experimental approach, many patients with hopelessly advanced cervical lymph node involvement were accepted for treatment, in order that the response of the primary disease might be evaluated. This explains the large number of deaths in the first year of the post-therapy period. It was recognized that the high dose might well invite necrosis, but the surgical department stood by to repair such damage.

The term "massive roentgen therapy" is a relative one and originally referred to the high dose of 12,000 r. An arbitrary line was drawn at 7,000 r, and every effort was made to exceed this amount. Dosage was modified by the patient's general physical status and the ability of local tissues to tolerate irradiation.

Treatment methods and portals have been described in a previous communication (1). Briefly, we used an intra-oral cone, inserting the largest size that could be tolerated and trying to cover as much of the disease as possible. The cones ranged from 3.5 to 5.0 cm. in diameter. Almost

TIME FACTOR - RECURRENCE

	Conventional	Massive
NO. PATIENTS TREATED	54	83
RECURRENCE BEFORE 1 YEAR	36	27
RECURRENCE AFTER 1 YEAR	2	0

TABLE IV

all of the patients were edentulous, or were made so, which facilitated the use of large cones. The intra-oral cones with beveled ends allowed better exposure of the disease. The bulk of the cancer was covered in this manner, and it did not seem necessary to insist on complete coverage plus margins of normal tissue. Approximately half the total dosage was delivered through this intra-oral portal, and the rest was given through several external portals. The quality of the x-ray beam at 250 kv. was 1.4 mm. Cu h.v.l.

Treatment was begun with a daily intra-oral dose of 400 r (in air) plus 200 r (in air) through one of the external portals alternately. The tumor dose through the intra-oral portal ranged from 4,000 to 6,000 r. After the intra-oral therapy was completed, the rest of the dose was given through the lateral and submental external portals. Metastatic neck nodes were not purposely included in any of the external portals. Intra-oral treatment was given initially because the intra-oral cone was not well tolerated after radiation reaction appeared.

The number of patients treated by this dosage schedule is shown in Table III. The minimum tumor dose was 7,000 r, the

maximum 12,000 r, and the average 9,300 r. Treatment was given over a period of three or four weeks.

This method of treatment has given better control of the primary lesion. We had noted that recurrent disease usually appeared within the first year and that few patients showed recurrence after one year (Table IV). This observation parallels the experience with those patients who are treated by surgery (2). A one-year follow-up of the local disease was therefore selected as a statistical basis for establishing the control of the intra-oral cancer. It is important however, to determine the status of control as early as possible in order to institute immediate treatment to known or suspected metastatic nodes in the neck. The relative improvement in local control is shown in Table V. The primary cancer was controlled in almost half the patients (48 per cent) receiving massive roentgen therapy. In 15 patients, bone involvement was noted clinically or demonstrated by roentgenogram, and in only 4 of this group was the primary disease controlled.

ADVANCED INTRAORAL CANCER
CONTROL OF PRIMARY DISEASE

	Conventional Roentgen Therapy	Massive Roentgen Therapy
NO. PATIENTS TREATED	54	83
PRIMARY DISEASE CONTROLLED OVER 1 YEAR	6	40

TABLE V

ADVANCED INTRAORAL CANCER
MASSIVE ROENTGEN THERAPY
END RESULT – 83 PATIENTS

Time Following Therapy	Died With Cancer	Died With Intercurrent Disease	Alive With Cancer	Alive and Well
Less than 1 year	33			
1 - 1.9	16		2	5
2 - 2.9	1	1		2
3 - 3.9		2		8
4 - 4.9		1		1
5 - 5.9				7
6 - 6.9		1		2
7 - 7.9				1
Total	50	5	2	26

NOTE: The age at time of death of 5 individuals who died of intercurrent disease were as follows, 81, 82, 60, 76, 74.

TABLE VI

Better primary control having been achieved, one might inquire as to the ultimate fate of the patients. Most of them have been followed three or five years and none have been lost to follow-up. A total of 83 patients were treated by the massive dose schedule and the end-results are noted in Table VI. Twenty-three patients were alive and well at the end of a three-year follow-up. Results were better in those patients originally seen without lymph node involvement, as might be expected. Metastatic neck nodes were treated by surgery, radiation, or a combination of the two (Table VII). Therapy to the nodes

THERAPY OF METASTATIC NECK NODES - 59 PATIENTS

	No. Patients	Living 3 Years Without Disease
PRIMARY ONLY TREATED	39	5*
SURGERY	7	4
RADIATION	12	1
RADIATION & SURGERY	1	1
TOTAL	59	11

*Enlarged nodes disappeared during treatment of primary disease, indicating inflammation.

TABLE VII

was carried out as soon as the radiation reaction had subsided, and as early as it could be determined that there was no remaining local disease. Radical neck surgery was the most effective means of eradicating positive nodes in this group of patients.

A final and pertinent consideration is the incidence and significance of radiation sequelae. Immediate radiation breakdown or delayed radiation necrosis occurred in 18 of the 83 patients treated with massive dosage (Table VIII). This contrasts sharply with the occurrence of radiation necrosis in only 1 patient receiving conventional x-ray therapy. The explanation for this difference may be that the patients of the first group did not live long enough to experience this sequela. The changes varied in severity from localized soft-tissue ulceration to more extensive necrosis involving bone. Some patients were cured by conservative medical treatment, while others required surgical repair. The small soft-tissue ulcerations often responded to local measures and chemotherapy Larger tissue defects required surgical intervention, removal of the necrotic tissues and plastic procedures to repair the defects. It was the policy of the surgical department to remove any exposed bone, since experience had shown that healing rarely occurred under these circumstances. Superficial exposure of bone was treated by rongeur. When extensive necrosis of the mandible was present, it was necessary to resect that portion of the jaw and close the defect with plastic flaps. Prompt intervention has spared many patients the debilitating

RADIATION NECROSIS

	Conventional	Massive
NO. PATIENTS TREATED	54	83
SOFT TISSUE	0	7
BONE	1	11

TABLE VIII

pain and discomfort engendered by prolonged and ineffectual medical treatment.

It has not been necessary to curtail this roentgen therapy program to any appreciable degree because of tissue breakdown. Radiation therapy *per se* was

TUMOR DOSE VS. RADIONECROSIS

	NO. PATIENTS	NECROSIS
7,000 - 7,900 r	15	3
8,000 - 8,900	18	1
9,000 - 9,900	22	6
10,000 - 10,900	16	3
11,000 - 11,900	6	3
12,000 and over	6	2
TOTAL	83	18

TABLE IX

probably not solely responsible for the production of necrosis, but did appear to become a greater factor in the higher dose ranges (Table IX). We have tried to determine the dose level which would give the maximum cure rate without any significant increase in the incidence of necrosis (Table X). At the present time, the 9,000 to 10,000 r tumor dose range appears to be optimal. The incidence of radiation sequelae does not rise appreciably until the tumor dose exceeds the 10,000 r level.

ADVANCED INTRAORAL CANCER - 137 PATIENTS
PONDVILLE HOSPITAL 1946-1951
PRIMARY DISEASE CONTROL AND NECROSIS

Tumor Dose (r)	No. of Patients	Percent Controlled	Percent With Necrosis	Ratio of $\frac{\text{Necrosis}}{\text{Controlled}}$
7,000 - 8,999	33	36.3	12.1	.333
7,000 - 10,999	71	49.3	18.3	.370
9,000 - 10,999	38	60.5	23.8	.393
9,000 - 12,000	50	56.0	28.0	.500
7,000 - 12,000	83	48.2	21.7	.450
Under 7,000	54	11.1	1.9	.171

TABLE X

SUMMARY

Marked improvement in the control of advanced intra-oral cancer was noted when massive roentgen dosage was delivered. The optimal tumor dose appears to be in the range of 9,000 to 10,000 r, delivered over a period of about four weeks. This dosage schedule gave the highest rate of local tumor control without significant increase in radiation sequelae.

NOTE: We wish to thank Dr. Herbert Lombard for his assistance in the preparation of the statistical material.

43 Bay State Road
Boston 15, Mass.

REFERENCES

1. WHITE, G., AND CHRISTENSEN, W. R.: Control of Inoperable Oral Cancer with Massive Roentgen Therapy. New England J. Med. **245:** 719–723, Nov. 8, 1951.
2. TAYLOR, G. W., AND NATHANSON, I. T.: Personal communication.

SUMARIO

Mejor Dominio del Cáncer Oral Avanzado con la Roentgenoterapia Masiva

En el Hospital de Pondville, Masachúsets, entre 1944 y 1951, trataron 137 cánceres intraorales (lesiones locales extensas y otras que abarcaban tejidos contiguos). Antes de 1946, el tratamiento consistía en su mayor parte en irradiación roentgen externa hasta una dosis de 6,000 r al tumor. Sólo en 6 de 54 enfermos se cohibió de ese modo la afección primaria. Este fracaso del esfuerzo primario impedía todo ataque a las lesions metastáticas de los ganglios cervicales, dando por resultado que, de los 54 pacientes, sólo 1 se hallaba sano al cabo de tres años.

Un cambio de política terapéutica en 1947 comprendió dos factores: una dosis masiva—7,000 a 12,000 r—e irradiación a través de un cono intraoral y además por varias puertas externas. Con esa técnica, se dominó el tumor primario aproximadamente en la mitad de los casos, permitiendo esto emprender el ataque de las metástasis ganglionares cuando las había. De 83 enfermos que han recibido la dosificación masiva, 23 estaban vivos y sanos al cabo de tres años.

La dosis óptima parece ser de 9,000 a 10,000 r. Con esa cantidad, no se considera importante el aumento en la incidencia de secuelas postirradiatorias.

(For Discussion of this paper, see following page)

DISCUSSION

Milton Friedman, M.D. (New York): Dr. White and his collaborators have achieved these splendid results by the application of certain cardinal principles to the irradiation of advanced cancer.

1. The given tumor dose was dictated by the response of the tumor and not by the archaic shibboleth of 6,000 r for squamous-cell carcinoma. The range of tumor lethal dose for this lesion is 4,000 to 10,000 r in three to five weeks. The employment of the same dose for all tumors obviously results in excessive dosage for some and inadequate dosage for others.

2. Extensive lesions require larger doses than small lesions.

3. Irradiation of extensive lesions requires a flexible technic, which will permit modification and adaptation to a shrinking tumor.

4. The curative treatment of advanced cancer, whether by surgery or irradiation, entails a calculated risk of severe morbidity and permanent radiation injury. These injuries are usually due to factors beyond our control, and, if predestined, are unavoidable. The injuries are due to destruction originally produced by the tumor, to the large size of the post-irradiation defect which is vulnerable to infection, and to impaired recuperative powers.

Accepting these risks as inevitable in a certain percentage of cases, large doses of radiation will increase the number of arrests. From the ethical standpoint, I see no reason why the private patient should not have the same right to radionecrosis as the Clinic patient. Experience has indicated that his desire to live equals that of his indigent brother.

The keystones of Dr. White's approach are massive dosage and the intra-oral cone. The great value of the latter is that it makes it possible to shrink bulky lesions with minimal irradiation of normal tissues. The cone therefore permits massive doses and minimizes radionecrosis.

It must be recalled that the stated figure of 9,000 to 10,000 r is not necessarily an excessive biological dose, since much of it was delivered through a cone to a small volume of tissue, and small volumes require more roentgens for the same effect than larger volumes. Actually, if one relied on a predetermined dose of 6,000 r through an intra-oral cone, the tumor would be under-irradiated, since the small irradiated volume would sustain a reduced biological effect.

Primary Neurogenic Tumors of the Lung and Interlobar Fissures[1]

A Review of Clinical and Radiologic Findings in Reported Cases with Addition of Two New Cases

BRIT B. GAY, Jr., M.D., and JOSÉ BONMATI, M.D.

NEUROGENIC TUMORS of the lung and interlobar fissures are rare. In a review of the literature the authors could find only 8 complete case reports (3, 4, 7, 13, 14, 17). Seven additional cases with incomplete protocols were also found (2, 3, 6, 8, 11, 13). The 2 additional examples to be reported here bring the number to 17. A review of several articles reporting a total of 317 isolated pulmonary masses (1, 2, 6, 8, 12, 15, 16, 18) revealed only 3 neurogenic tumors, of which 1 was malignant (6) and 2 benign (2, 8).

PATHOLOGY

A detailed discussion of the pathology of neurogenic tumors is beyond the scope of this paper. Most authors classify them in two major groups: tumors of the sympathetic nervous system (ganglioneuroma, ganglioneuroblastoma, and neuroblastoma) and tumors of nerve-sheath origin (neurilemmoma, neurofibroma, malignant schwannoma, neurofibrosarcoma) (3). The term "neurinoma" appears occasionally in the literature, supposedly denoting a pure nerve-cell origin with no nerve-sheath elements. Many authors do not include this term in classifications of neurogenic tumors, since practically all of these are of nerve-sheath origin, and neurofibroma is a more applicable designation (3).

Benign and malignant variants are present in both groups of neurogenic tumors. It is frequently impossible to differentiate by radiologic or clinical means the benign from the malignant neurogenic tumor. In Kent's series (9), 37 per cent of the tumors were malignant.

The following neurogenic tumors have been reported in the literature:

1. Benign neurogenic tumors, arising within lung tissue, 10 cases (2, 3, 5, 7, 8, 13, 14, 17). We add 2 cases.
2. Benign neurogenic tumors arising in the interlobar fissure, 2 cases (3, 4).
3. Malignant neurogenic tumors arising within lung tissue, 3 cases (6, 7, 11).

ANATOMIC LOCATION OF REPORTED NEUROGENIC TUMORS OF LUNG

Of the 9 solitary neurogenic tumors of the lung, 2 were reported as being within the interlobar fissures (3, 4). Of the remaining 7 cases (including the authors'), the tumor was in the right upper lobe in 2 instances (13; Case I, below), in the right middle lobe in 2 instances (5, 7), in the right lower lobe in 2 instances (17; Case II, below), and in the left upper lobe once (7). Tumors were multiple and bilateral in 1 case (14).

CLINICAL MANIFESTATIONS

Of the 10 patients (including the authors') for whom complete case protocols are available, 7 had no clinical manifestations referable to the pulmonary mass. Hemoptysis, left chest pain, dyspnea, and asthmatic attacks were present in 1 case of multiple neurofibromata of the lungs described by Rubin and Aronson (14). In 1 case of primary neurogenic sarcoma of the lung reported by Diveley and Daniel (7), in a forty-eight-year-old white male, the clinical course was suggestive of carcinoma of the lung (45 pounds weight loss, pneumonia-like attacks, fever, productive cough). Castleman (13) described a solitary neurofibroma of the lung in an eighteen-year-old male producing recurrent severe hemoptysis; the lesion

[1] From the Department of Radiology, Emory University School of Medicine and Emory University Hospital, Emory University, Ga. Accepted for publication in August 1953.

eventually cavitated and ruptured into the right pleural space. Castleman also mentioned the case of a thirty-year-old white male who had bronchial obstruction and hemoptysis due to a pulmonary neurofibroma. Casson (5) reported a benign neurinoma of the right middle lobe with weight loss but no pulmonary symptoms.

The age incidence of neurogenic tumors of the lung is variable. The earliest occurrence is reported here, in a boy of two and a half years (Case I). Of the remaining cases, 3 were seen in the second decade (3, 13, 17); 1 in the third (5); 2 in the fourth (7, 13); 3 in the fifth (4, 7, and the authors' Case II), and 2 in the sixth (3, 14).

RADIOLOGIC MANIFESTATIONS

Routine chest radiography is the most important single examination for the discovery of neurogenic tumors of the lung. Of the 10 cases having complete protocols (including the authors'), 7 were discovered on routine films of the chest.

Most often these neurogenic tumors of the lung and interlobar fissures appear as well circumscribed, rounded or lobulated masses. The lesion in one of our patients was lobulated, and prominent vascular trunks extended between it and the hilus, strongly suggesting a diagnosis of pulmonary arteriovenous fistula. Most of the neurogenic tumors of the lung are located peripherally, but in the case reported by Bartlett and Adams (4) the mass was in the left hilus. The tumor may completely replace a lobe of lung and simulate pneumonia, as in the case of neurogenic sarcoma reported by Diveley and Daniel (7).

The reported neurogenic tumors of the lung and interlobar fissures have varied in size from 2 to 11 cm.

Segmental atelectasis may be the only manifestation radiographically in cases where the tumor is endobronchial, as mentioned by Castleman (13).

Radiographically demonstrable calcifications have not been described in the reported neurogenic tumors of the lung and interlobar fissures. Areas of microscopic calcification were present in the cases to be reported here, but these could not be visualized roentgenographically.

Cystic degeneration and necrosis in neurogenic tumors are commonly present (3). Cavitation may become apparent radiographically if the tumor communicates with a bronchus. This occurred following biopsy in the case of multiple neurofibromata of the lungs reported by Rubin and Aronson (14).

In all but one of the reported cases, the neurogenic tumor of the lung was solitary. Rubin and Aronson's patient was a fifty-seven-year-old colored female diabetic with multiple nodular densities in both lungs, simulating pulmonary metastases. At autopsy these proved to be multiple neurofibromata; the patient had no evidence of systemic neurofibromatosis.

DIFFERENTIAL DIAGNOSIS

There is nothing characteristic in the clinical or radiologic picture that establishes the diagnosis of neurogenic tumor of the lung or interlobar fissure. In the reported cases the lesion has simulated a variety of conditions:

1. Pulmonary neurofibromata may have an identical appearance radiologically with other primary *pulmonary tumors* (carcinoma, bronchial adenoma, solitary metastases). Barium studies of the esophagus may be helpful in differential diagnosis. The presence of mediastinal nodes compressing the esophagus is evidence against a benign neurogenic tumor of the lung and favors a bronchogenic cancer.

2. *Calcium-containing pulmonary nodules* are more likely not to be neurogenic tumor of the lung or interlobar fissure. In the reported cases of neurogenic tumors of the lung, radiologically demonstrable calcium has not been described; thus, when a pulmonary lesion contains calcium, more likely possibilities are granuloma or hamartoma.

3. *Bronchogenic cysts* may have the same appearance as neurogenic pulmonary tumors.

4. *Cavitary lesions*, such as tuberculosis,

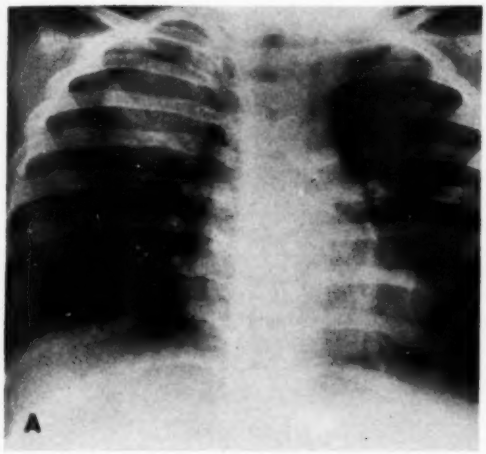


Fig. 1A. Case I: Postero-anterior roentgenogram of the chest. There is a 5-cm. round mass in the posterior segment of the right upper lobe.

abscess, infected cyst or bulla, and cavitating carcinoma of the lung, may be suggested when a neurogenic tumor becomes necrotic and ruptures into a bronchus.

5. *Pulmonary arteriovenous fistulas* may be simulated by a neurogenic tumor of the lung, as in one of the cases reported here. An angiocardiogram will differentiate these two lesions.

6. *Massive pleural effusion* has been simulated by a pulmonary neurogenic tumor reported by Ackerman and Taylor (3). In this case the tumor filled one-half of the chest, producing a complete opacity.

7. *Pulmonary atelectasis* may be produced by neurogenic tumors of the lung in the same manner as by carcinoma, foreign body, and bronchial adenoma.

CASE REPORTS

CASE I: J. E. A., a 2 1/2-year-old white male, was asymptomatic and in good health. A routine pretonsillectomy roentgenogram of the chest revealed a rounded mass in the apex of the right lung. No significant clinical findings were present.

Radiologic studies revealed a large round mass, 5 cm. in diameter, in the posterior segment of the right upper lobe. No calcification was noted. No mediastinal masses were visible (Figs. 1A and 1B).

A right upper lobectomy was performed by Dr. Osler Abbott.

Gross Pathology: In the right upper lobe specimen was a 3.5-cm. firm mass surrounded by lung tissue. On cut section, the tumor was of a yellowish-gray color.

Fig. 1B. Case I. Lateral roentgenogram of chest, revealing the mass in the posterior segment of the right upper lobe. No calcification can be noted.

Microscopic Pathology: The tumor consisted of long spindle-shaped cells in interlacing bundles closely resembling nerve sheath tissue. Punctate calcium deposits were prominent in several areas. There was nothing to suggest malignancy.

Pathologic Diagnosis (Dr. Abner Golden): Neurofibroma, right upper lobe.

CASE II: W. C. P., a 41-year-old white male, was found to have a lobulated mass in the right lower lung field in the course of a routine Public Health chest survey. He was entirely asymptomatic. A second tumor had been present on the right lower lateral chest wall since birth.

Roentgenograms of the chest revealed a 6 × 3-cm. lobulated mass in the posterior basilar segment of the right lower lobe; this contained no calcium (Fig. 2). Angiocardiographic studies showed no opacification of the mass.

Roentgenograms of the right chest wall disclosed a soft-tissue mass, 8 × 11 cm., which contained numerous calcium deposits. No rib deformities were noted.

At operation (Drs. Abbott and Hopkins), the superficial tumor was excised and a right lower lobectomy was performed.

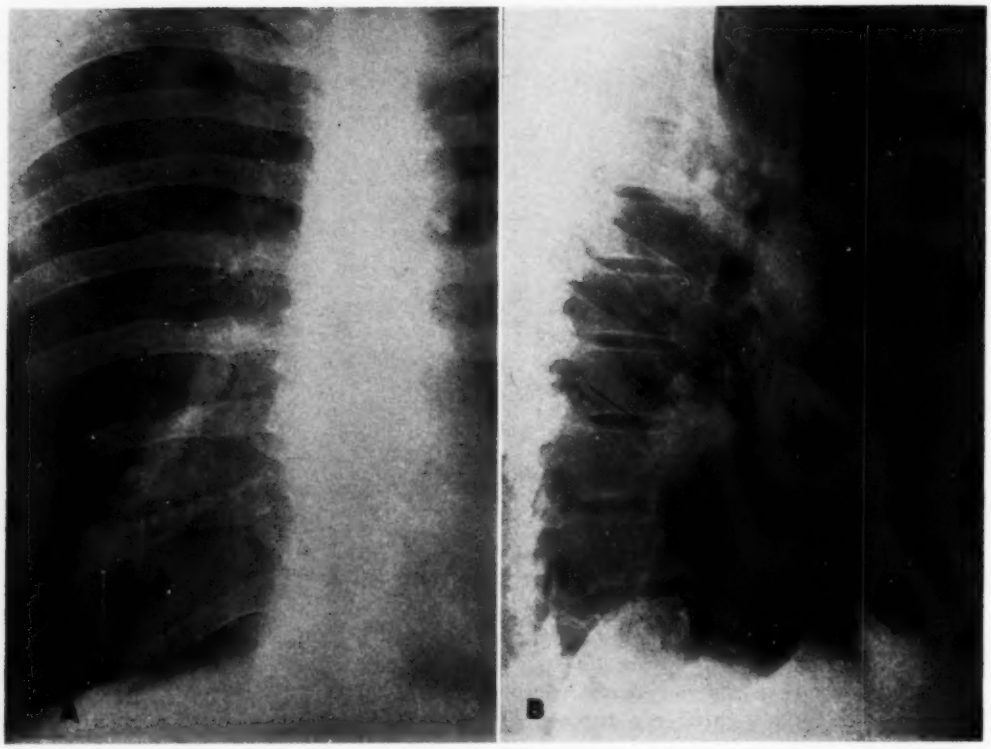


Fig. 2. Case II. A. Postero-anterior roentgenogram of the chest. There is a lobulated mass in the posterior basilar division of the right lower lobe. Angiocardiography excluded an arteriovenous fistula.
B. Lateral roentgenogram of the chest showing the mass in the posterior basilar segment of the right lower lobe. No calcification is present.

Gross Pathology: One specimen consisted of the right lower lobe, within which was a large lobulated, nodular tumor. All bronchi except that of the median basilar segment were obstructed. Distal to the tumor a secondary abscess was noted in one area. On cutting the specimen, the tumor was found to be encapsulated; it measured $5 \times 4 \times 3.5$ cm. and was of a gray-white color. Also submitted was a second encapsulated cystic mass measuring $12.5 \times 9.2 \times 5.3$ cm., which was partially covered by skin. On cut section, this latter tumor contained large cystic areas and calcification.

Microscopic Pathology: The intrapulmonary tumor was composed of numerous wavy bundles of loosely scattered oval to spindle-shaped cells. In some areas, the tumor was very cellular, with frequent small scattered areas of calcification. The tumor nodules lying in relation to the bronchial branches were covered by an intact bronchial mucosa. The tumor removed from the thoracic wall showed the same microscopic characteristics as the intrapulmonary tumor.

Pathologic Diagnosis (Dr. Abner Golden): Neurofibromas of the right lower lobe and of the chest wall.

SUMMARY

Neurogenic tumors most often occur in the posterior mediastinum. Rarely they arise primarily in the lung or interlobar fissures. Only 15 cases of neurogenic tumors of the lung and interlobar fissures could be found in the literature (8 with complete case protocols). Two additional cases are reported here. There are no specific clinical or radiologic signs to suggest the diagnosis. Most often the roentgenogram will reveal a well circumscribed homogeneous density, rounded or lobulated, without calcium content. Treatment is surgical.

ACKNOWLEDGMENTS: Greatful acknowledgment is given Drs. Osler A. Abbott and William A. Hopkins of the Thoracic Surgical Service, Emory University Clinic, for use of clinical and operative data on cases reported herein.

REFERENCES

1. ABBOTT, O. A., HOPKINS, W. A., LEIGH, T. F., AND VAN FLEIT, W. E.: Significance and Management of Peripheral Pulmonary Masses. J. M. A. Georgia **40**: 243–249, June 1951.
2. ABELES, H., AND EHRLICH, D.: Single Circumscribed Intrathoracic Densities. New England J. Med. **244**: 85–88, Jan. 18, 1951.
3. ACKERMAN, L. V., AND TAYLOR, F. H.: Neurogenous Tumors within the Thorax. Cancer **4**: 669–691, July 1951.
4. BARTLETT, J. P., AND ADAMS, W. E.: Solitary Primary Neurogenic Tumor of the Lung. Report of Case. J. Thoracic Surg. **15**: 251–260, August 1946.
5. CASSON, R.: Neurinomes intrapulmonaires. J. radiol. et d'électrol. **31**: 578–579, 1950.
6. DAVIS, E. W., AND KLEPSER, R. G.: Symposium on Diagnosis and Treatment of Premalignant Conditions; the Significance of Solitary Intrapulmonary Tumors. S. Clin. North America **30**: 1707–1715, December 1950.
7. DIVELEY, W., AND DANIEL, R. A., JR.: Primary Solitary Neurogenic Tumors of the Lung. J. Thoracic Surg. **21**: 194–201, February 1951.
8. EFFLER, D. B., BLADES, B., AND MARKS, E.: The Problem of the Solitary Lung Tumors. Surgery **24**: 917–928, December 1948.
9. KENT, E. M., BLADES, B., VALLE, A. R., AND GRAHAM, E. A.: Intrathoracic Neurogenic Tumors. J. Thoracic Surg. **13**: 116–161, April 1944.
10. KLASSEN, K. P., PATTON R., AND BEMEN, F. M.: Neurofibroma of the Diaphragm. J. Thoracic Surg. **14**: 407–413, October 1945.
11. MEADE, R. H., JR., KAY, E. B., AND HUGHES, F. A., JR.: A Report of 196 Lobectomies Performed at Kennedy General Hospital Chest Surgical Center from 1943–1946 with One Death. J. Thoracic Surg. **16**: 16–29, February 1947.
12. O'BRIEN, E. J., TUTTLE, W. M., AND FERKANEV, J. E.: Management of Pulmonary "Coin" Lesions. S. Clin. North America **28**: 1313–1322, October 1948.
13. CASTLEMAN, B. Case Records of the Massachusetts General Hospital. Case No. 29462. New England J. Med. **229**: 789–793, Nov. 18, 1943.
14. RUBIN, E. H., AND ARONSON, W.: Primary Neurofibroma of the Lung. Am. Rev. Tuberc. **41**: 801–805, June 1940.
15. SHARP, D. G., AND KINSELLA, T. J.: Significance of the Isolated Pulmonary Nodule. Minnesota Med. **33**: 886–888, September 1950.
16. THORNTON, T. F., JR., ADAMS, W. E., AND BLOCH, R. G.: Solitary Circumscribed Tumors of the Lung. Surg., Gynec. & Obst. **78**: 364–370, April 1944.
17. TOUROFF, A. S. W., AND SAPIN, S. O.: Solitary Intrathoracic Neurofibroma. Report of 2 Unusual Cases. Surgery **26**: 787–798, November 1949.
18. WOLPAW, S. E.: The Diagnosis and Management of Asymptomatic Isolated Intrathoracic Nodules. Ann. Int. Med. **37**: 489–505, September 1952.

Emory University Hospital
Emory University, Ga.

SUMARIO

Tumores Primarios del Pulmón y de las Fisuras Interlobulares: Repaso de los Hallazgos Clínicos y Radiológicos en los Casos Ya Communicados con la Adición de Dos Nuevos

Los tumores neurógenos radican más a menudo en el mediastino posterior, teniendo raramente su origen primario en el pulmón o en las fisuras interlobulares. En la literatura, no se han podido encontrar más que 15 casos de tumores neurógenos del pulmón y de las fisuras interlobulares (8 de ellos con protocolos clínicos completos). Preséntanse aquí dos casos más. No hay signos clínicos o radiológicos específicos que sugieran el diagnóstico. Lo más a menudo revelará la radiografía una densidad homogénea y bien circunscrita, ya redonda o lobulada, sin contenido de calcio. El tratamiento es quirúrgico.

A Roentgen Study of Osteogenic Sarcoma Developing in Paget's Disease[1]

ROBERT S. SHERMAN, M.D., and KENNETH Y. SOONG, M.D.

IN 1889, Paget (16) in a paper dealing with the relationship of osteitis deformans and osteogenic sarcoma concluded that he could not venture to guess what the nature of the connection was between these two diseases. His study was based on the observation of 5 cases of cancer or sarcoma developing in 23 patients having osteitis deformans. To date, records of more than a hundred osteogenic sarcomas occurring with Paget's disease have appeared in the literature and yet no further insight is provided regarding the fundamental relationship between these two conditions.

Summey and Pressly (20) in 1946 summarized the available reports and added a number of cases of their own, making a total of 76. Sear (18) reported additional material in 1949 and commented in a general way upon the roentgen appearance of these two diseases when found together. Since there has been no study devoted solely to an analysis of the roentgen findings based upon a representative volume, it was thought worth while to examine the material available at Memorial Center. Nineteen biopsy-proved cases of osteogenic sarcoma occurring in areas of Paget's disease were selected. All had adequate x-ray coverage, often extending over a period of some time, so that interval change could be observed. The objective, therefore, was to set up criteria for prompt x-ray detection of osteogenic sarcoma associated with Paget's disease in order that this dangerous complication might be treated as early as possible. To this end, general information regarding the incidence of osteogenic sarcoma in Paget's disease will be pertinent, as will a brief discussion of roentgenologic types of both conditions. It also seems indicated to include a few statements summarizing this material as to age, sex, symptoms, signs, and course of the cancerous disease, since information of this nature may be of some value in formulating intelligent roentgen opinion.

The incidence of sarcomatous degeneration in Paget's disease varies according to different observers. The following is a tabulation of some of the estimates:

	Per cent
Packard *et al.* (15)	7.5
Da Costa *et al.* (6)	9.5
Gruner *et al.* (10)	9.0
Bird (1)	11.0
Geschickter and Copeland (9)	5–7
Sear (17)	2.0

It is conceivable that the incidence is not actually as high as many statistics show, because of the difficulty of finding every patient with osteitis deformans. Roentgenologists well know that many cases are picked up unexpectedly in the course of studies directed to other objectives. Furthermore, many are never recognized because no x-ray examinations are made, a significant proportion of patients with the disease being quite asymptomatic.

As Paget recognized nearly a century ago, it is quite evident that the relation between osteitis deformans and bone sarcoma is real. From this standpoint, it is interesting to note other diseases of bone associated with the development of sarcoma. The possibility of malignant change in the various forms of internal and external osteochondromata is well known. Several instances of bone sarcoma developing in fibrous dysplasia have been noted (5, 9). Also that irradiated bone may at times give rise to osteogenic sarcoma seems now to have been demonstrated (3, 11). The development of osteogenic sarcoma in radium dial painters has

[1] From the Department of X-ray Diagnosis, Memorial Center, New York, N. Y. Accepted for publication in August 1953.

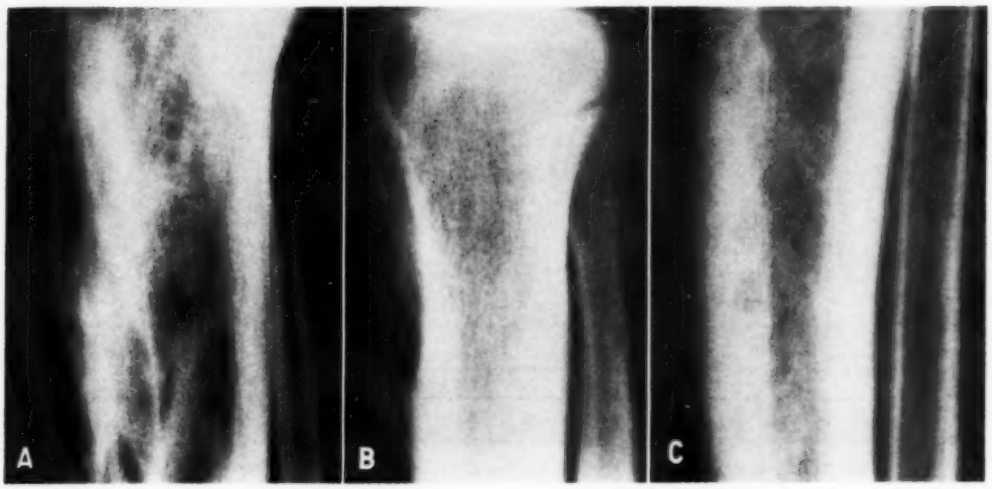


Fig. 1. Osteitis deformans. A. Common form. B. Osteoporotic form. C. Sclerotic form.

long been recognized (12). Sarcoma arising in myositis ossificans is known (2, 14), and the question of sarcoma originating from the callus of a fracture has also been raised (9). One suspects, however, that the association between osteitis deformans and osteogenic sarcoma is one of the most frequent and hence the most significant.

With 3 exceptions, the 19 patients of this series were over fifty years of age. The mean age was sixty; the youngest patient was thirty-eight and the oldest seventy-five. It is generally known that many osteogenic sarcomas occurring in individuals in the higher age range are associated with Paget's disease. In one group of osteogenic sarcoma patients, 40 per cent of those in the age range of fifty-five to seventy years showed associated osteitis deformans (4).

Osteogenic sarcoma in Paget's disease seems to have about the same sex incidence as is found in ordinary osteogenic sarcoma, 13 of our 19 cases being in men. This ratio of about 2 to 1 in favor of males was reported in a number of studies in the literature on osteogenic sarcoma developing in Paget's disease, though male preponderance was not conclusive in uncomplicated Paget's disease (13, 20).

Four of this series of patients had known Paget's disease prior to the appearance of the sarcoma. The length of their history ranged from seven to as long as twenty years. One suspects that the proportion of recognized Paget's disease would be significantly higher if more thorough histories had been obtained and if more roentgenographic studies had been made. Sixteen of the present group showed multiple bone involvement by osteitis deformans and in the remainder the lesions were monostotic as far as is known. Needless to say, there was not complete coverage of all bones in each instance, so that the figures are not necessarily reliable in the monostotic group.

Well developed and fairly widespread lesions of osteitis deformans were present in these patients. In no instance was there any doubt about the reliability of the x-ray diagnosis, since diagnostic dependability constituted one of the bases for the selection of the material. The lesions were of the common variety (Fig. 1A) rather than the less frequent osteoporotic (Fig. 1B) or dense sclerotic (Fig. 1C) forms. Sear (18) mentioned that sarcomatous changes were less likely to develop in the sclerotic variety of the disease. Typical x-ray findings of Paget's disease—bone enlargement, bowing, widening of the cor-

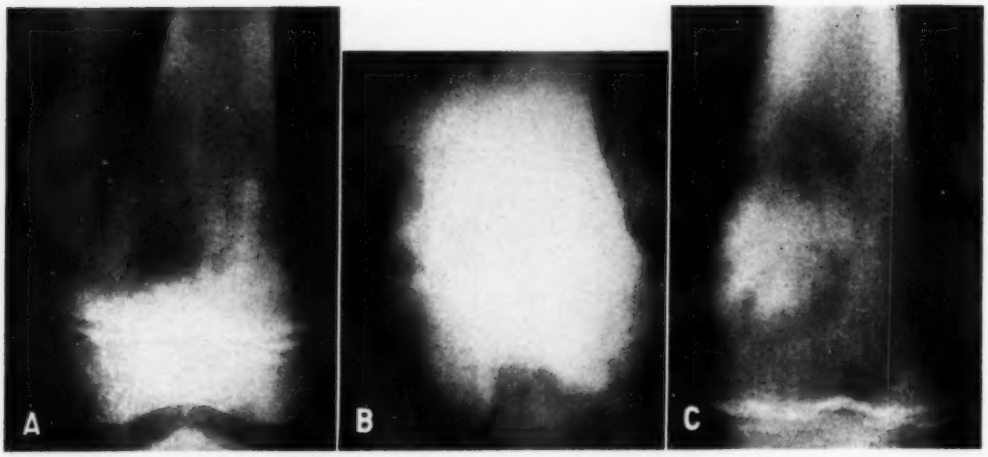


Fig. 2. Osteogenic sarcoma. A. Lytic form. B. Sclerosing form. C. Mixed form.

Fig. 3. Osteogenic sarcoma developing in Paget's disease, with metastasis to the right scapula and left clavicle.

tex in a characteristic pulled-out manner, development of an abnormal texture due to dense striae with occasional patchy areas of radiolucence, sometimes a peripheral radiolucent zone, and at times small transverse cortical infractions—were seen. Besides the x-ray evidence of the disease, correlative clinical findings were often available. There was a supportive laboratory finding: an elevated alkaline phosphatase in all cases, with values ranging from 7.2 to 111 Bodansky units. The average figure was 42. In most of the cases the presence of Paget's disease was confirmed by histologic examination. In the presence of typical x-ray findings, this histologic confirmation was not held to be essential, as biopsy specimens may not always include the pagetoid bone. In other words, a negative histologic report for Paget's disease did not necessarily preclude inclusion of the case in this study.

We use a simple way of classifying osteogenic sarcoma roentgenographically. It is based first upon the apparent site of origin, *i.e.*, either from bone itself or the neighboring structures, especially the periosteum, and secondly upon the relative degree of destruction or production as seen in the x-ray film, the basis for comparison being the density of normal bone. Those osteogenic sarcomas arising from bone are classified as lytic, sclerotic, and mixed, the last having an approximate balance between the amounts of destruction and production (Fig. 2A, B, C). The less common types of periosteal or extraosseous origin were not found in this series, and we know of no cases reported in the literature of an association of these forms with osteitis deformans. In this material there were 14 tumors that were lytic, 7 mixed, and 1 of the sclerotic variety.

Fifteen patients presented a single sarcoma, while in 3 there were two cancerous areas. In a final case, a single sarcoma

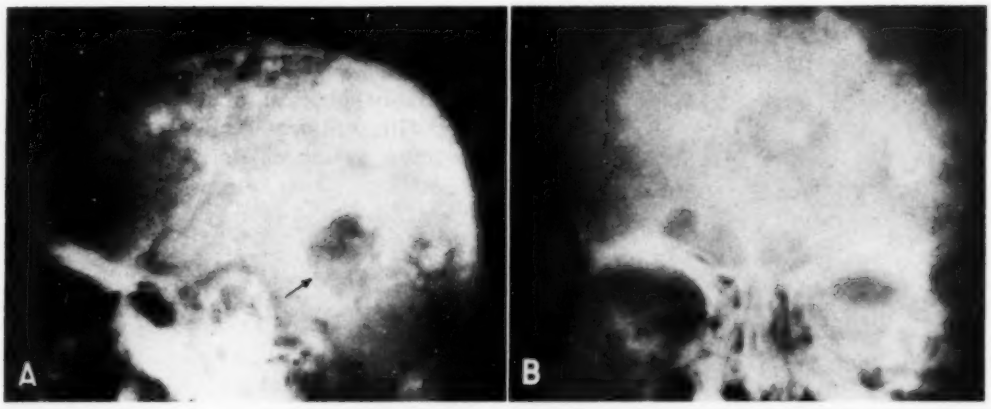


Fig. 4. Two examples of osteogenic sarcoma developing in Paget's disease in the skull.

was found with two osteolytic lesions in normal bone (Fig. 3). Whether these two osteolytic lesions were multicentric sarcomas or metastatic lesions could not be determined, but one assumes they were metastatic. Generally speaking, primary osteogenic sarcomas and metastatic deposits from osteogenic sarcoma are indistinguishable histologically (8). Excluding these two lesions, the present material consists of 22 sarcomas in 19 patients. All were proved histologically, mostly on the basis of a surgical specimen or regular biopsy, although in 3 aspiration biopsy was employed. Osteogenic sarcoma was reported in all but 1 case, which was diagnosed as spindle-cell sarcoma by aspiration. Chondrosarcomas and fibrosarcomas, which have been reported in the literture (19), were not seen in the present series of cases.

Pain, "arthritis," fracture, and a pulsating mass were the usual complaints that brought these patients to medical attention. Eleven had pain and "arthritis" for more than a year, while 8 had complaints of only two to eight months duration. Three were first seen elsewhere because of fracture. All were handled initially either as having a simple fracture or a pathological break due only to Paget's disease. In none was the real nature of the deadly complication recognized at first. All 3 patients presenting a pulsating mass had a sarcoma in the vault of the skull.

ROENTGENOLOGIC FINDINGS

The following is a list of the bones in which the 22 sarcomas were found in the 19 patients:

Humerus		8
Pelvis		5
Ischium	2	
Ilium	2	
Pubis	1	
Skull		4
Cranial vault	3	
Mastoid	1	
Femur		2
Scapula		1
Tibia		1
Radius		1

Twelve were in the long bones and 10 in the flat bones. In the former no significant predilection for the diaphysis or the metaphysis was exhibited, but there seemed to be no question that mid-shaft involvement was more common than we have found to be the case with simple osteogenic sarcoma.

As to the site of origin of the tumor, *i.e.*, whether it appeared to arise from the cortex or the medulla, 16 of the osteogenic sarcomas were thought to have had their origin in the medullary part of the bone. Two more probably arose from this location, and 2 probably arose from the cortex. In the 2 others the primary site could not be determined with assurance. None, however, were thought to be of periosteal origin.

The shape of the osteogenic sarcomas

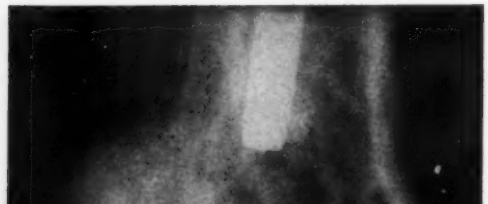


Fig. 5. Osteogenic sarcoma developing in Paget's disease, lytic form.

varied from spherical to fusiform. In establishing this characteristic, the entire extent of the tumor was judged, including both intraosseous and extraosseous parts. The commonest shape was oval, 16 tumors showing this configuration. Four were spherical and 2 were fusiform. Speaking generally, those in the skull were spherical, those in the mid-shaft were fusiform, and those in the pelvis oval.

All the osteogenic sarcomas revealed an ill-defined boundary in the roentgenogram except for the 3 in the vault of the skull, which had a fairly precise margin with a thin sclerotic border.

In view of its rarity and unique clinical characteristics, osteogenic sarcoma in the cranial vault deserves special mention. Only 8 bone sarcomas in the cranial vault were found among a series of 700 primary bone sarcomas (9). They were described as sclerosing and osteolytic varieties. There were 3 osteogenic sarcomas in Paget's disease of the cranial vault in the present series (Fig. 4). They were all of the osteolytic variety. The presence of a pulsating mass was the most important clinical characteristic of this sarcoma. It was this which brought each patient to medical attention. Destruction of both tables and diploe with external and probably internal extension was the rule in the roentgenogram. The tumors were invariably spherical, about 4 cm. in diameter, with well demarcated boundaries and at times a thin sclerotic border. When

Fig. 6. Osteogenic sarcoma developing in Paget's disease, mixed form.

small, these sarcomas were quite difficult to differentiate, on a single full-face view, from zones of radiolucence in an uncomplicated pagetoid skull. Efforts should always be made to obtain a tangential view of the involved area in order to appreciate the destruction of tables with soft-tissue extension. When the latter finding was present as well as the pulsating mass, the diagnosis of malignant degeneration would seem to be certain.

The internal pattern is frequently an important distinguishing feature in the roentgen diagnosis of bone tumors. While the broad aspects of this subject have already been touched upon in the x-ray

classification of tumors, a complete evaluation of the internal structure goes further than merely classifying sarcomas as lytic, mixed, or sclerotic. Naturally in those tumors that are entirely lytic or destructive there will be no pattern or internal structure, the tumor area presenting a uniform radiolucence as compared to normal bone (Fig. 5). Nine of the total 14 lytic lesions were of this order. There remain, therefore, an additional 5 lytic tumors which, although showing a predominance of bone destruction, did reveal enough productive change so that some arrangement of densities within the tumors could be recognized. One of these showed a slight density around the periphery (Fig. 4B); another presented a few incomplete septa. Three had fine scattered calcific deposits within the mass (Fig. 8C). Most of the 7 mixed tumors presented a disorganized pattern made up of patches of sclerosis and destruction, a few having calcific nodule formation (Fig. 6). The

Fig. 7. Osteogenic sarcoma developing in Paget's disease, sclerosing form.

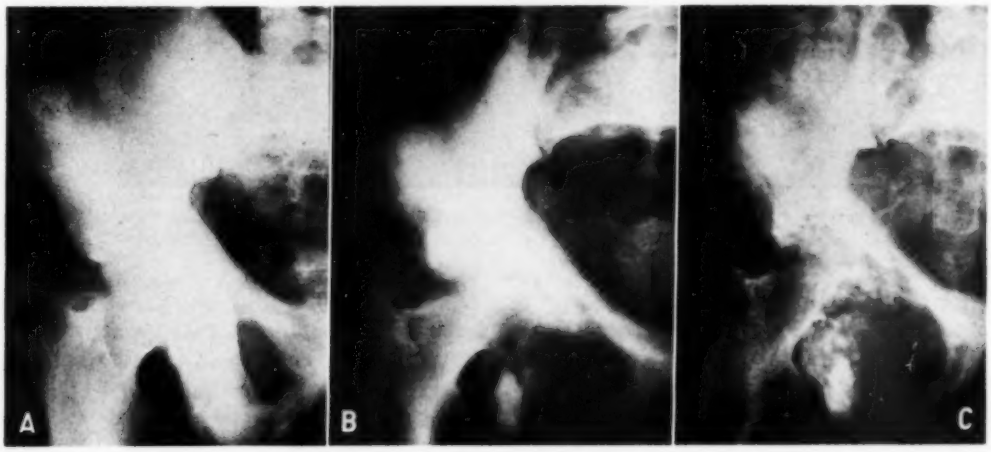


Fig. 8. A. Paget's disease of pelvis. B. Same patient eleven months later. Appearance of osteogenic sarcoma in right ischium. C. Same patient eighteen months later with further extension of sarcoma.

productive or sclerotic tumor has a dense irregular structure (Fig. 7).

The size of the osteogenic sarcomas was measured and the results are summarized as follows:

Diameter in inches.....	1	2	3	4	5	6	7	8
Number of tumors.....	2	8	5	4	2	0	0	1

The alignment of a tumor in a long bone is sometimes a fairly constant and characteristic point of x-ray diagnosis. When the axis of the tumor corresponds to the long or central axis of the bone, it can be considered to be in a symmetrical position. When it is out of this axis in either or both

sagittal or lateral views, it must be considered to be asymmetrical. In the present material there were 10 tumors in which this concept did not apply, as they were in the flat bones. Of the 12 tumors in which it did apply, 4 were symmetrical and 8 asymmetrical.

Twenty osteogenic sarcomas revealed cortical destruction, while in 2 the condition of the cortex could not be passed upon with assurance. At times the amount of cortical bone loss exceeded the extent of the medullary destruction. Of 12 long-bone sarcomas, 8 showed an initial or subsequent pathological fracture.

Periosteal reaction was conspicuously rare. Only 2 tumors revealed a slight degree of periosteal reaction of the parallel type. In the remaining 20 there was no periosteal elevation. No example of the perpendicular or sunburst form was seen.

The tumors showed varying amounts of soft-tissue extension in 17 instances; in 5 no soft-tissue formation was found. In those with mass formation, the mass was large in 5 instances, of moderate size in 7, and small in 5. The judgment of the size of the mass was based upon the relationship of the extraosseous extension and the area of bone involvement.

In our experience, joint invasion is not commonly seen in ordinary osteogenic sarcoma. This is also true for osteogenic sarcoma in osteitis deformans. In this series only 3 tumors extended into the nearby joint but did not cross it. Extension across a joint may occur in late stages of the disease. Of particular interest was a case of sarcoma of the scapula in which the clavicle was involved by virtue of extension in contiguity from the coracoid process, while the acromioclavicular joint remained intact. There were 8 tumors in which no relationship to a joint was present because these were either in the skull or mid-shaft in location.

An observation of the growth rate of these tumors was made possible in a number of cases by a comparison of interval films. Altogether there were 8 tumors observed over a period ranging from two

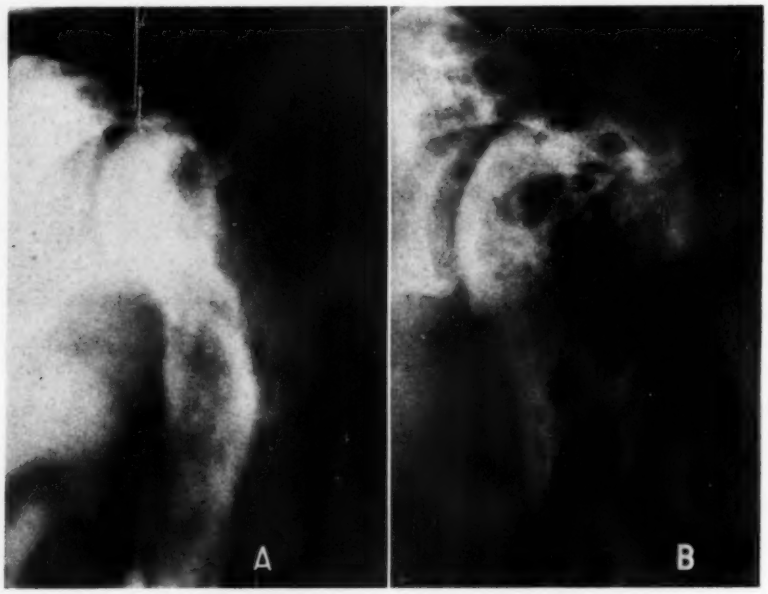


Fig. 9. A. Osteogenic sarcoma developing on Paget's disease, lytic form, with soft-tissue mass and pathological fracture. B. Same patient three years later, with bone regeneration following roentgen therapy.

to eleven months. The rate of growth is indicated in the following table:

Case No.	Months	Amount of Increase
1	2	3 times
2	3	10 "
3	5	9 "
4	6	2 "
5	8	2 "
6	9	2 "
7	10	2 "
8	11	From no evident tumor to a mass 5 inches in diameter (Fig. 8)

roentgen therapy upon a few of the treated tumors as evidenced by the changes in the interval roentgenograms. In the patient who survived five years there was definite bone regeneration (Fig. 9). In 3 there was no real change, while in 2 others there was continued growth.

Contrary to other opinion (7), pulmonary metastasis was a somewhat common sequel, developing in 11 of the 19 patients. We do not see any reason to distinguish this tumor from ordinary osteogenic sarcoma in this respect.

Fig. 10. A. Osteogenic sarcoma developing in Paget's disease, lytic form, with subcortical destruction and subsequent destruction of the cortex. B. Second focus of osteogenic sarcoma in the radius in the same patient.

Although we have not made similar comparison with osteogenic sarcoma occurring in normal bone, it is our impression that the growth rate of osteogenic sarcoma associated with Paget's disease is the more rapid.

Altogether 12 patients received varying amounts of roentgen therapy. There was no accurate account as to the quality and the quantity of the radiation in all instances. Usually a temporary symptomatic regression occurred. With a single exception, subsequent progression of the disease was the rule. This 1 patient survived five years following roentgen therapy and died of heart disease. We were able to observe the effect of the

In addition to the 19 proved cases that have been analyzed, there were 3 other cases of malignant tumor associated with Paget's disease. We have no specific biopsy proof, however, that these malignant tumors were actually osteogenic sarcomas. Although the weight of evidence favored such a diagnosis, the pathological report read solely "malignant tumor." As far as could be learned, there were no primary tumors which might have given rise to bone metastases. Two of these tumors showed a lytic pattern, with no internal structure, while the other was

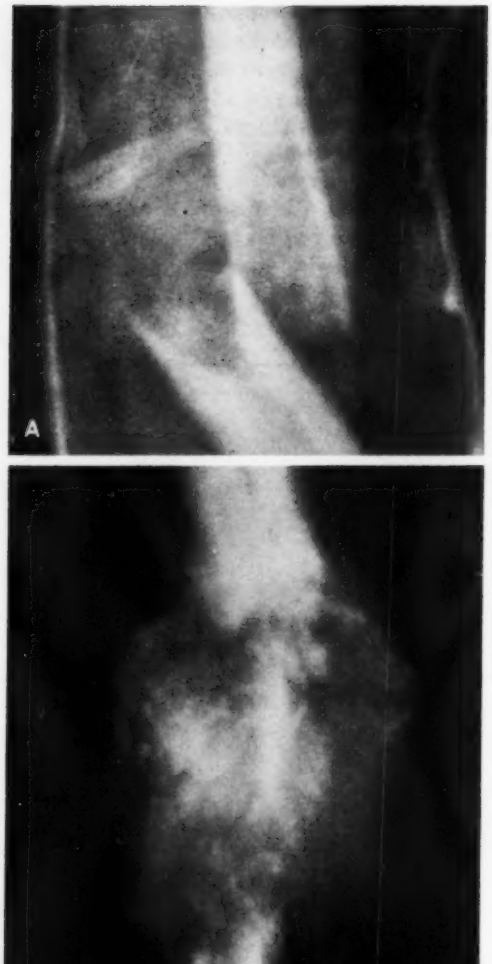


Fig. 11. A. Pathological fracture of pagetoid bone, with bone loss at the site of fracture unrecognized initially. B. Appearance of sarcomatous changes two months later, in same patient.

sclerotic. All were of oval shape with ill-defined borders. The cortex was invariably destroyed to some degree and there was no periosteal reaction. In one instance, a moderate-sized mass was present, and in the other a small mass. Pathological fracture was observed in 2 instances. There was no joint involvement. The tumors measured 8, 3, and 6 inches respectively. One doubled its size in four months. All were symmetrical. In 1 case there were additional bone lesions in the skull, scapula, and femur.

Summary of Roentgen Findings: Osteogenic sarcoma usually develops in the common roentgenologic type of osteitis deformans as an area of bone destruction, initially subcortical in location with constant subsequent cortical destruction. Occasionally a pathological fracture or a pulsating mass is the first clinical sign of malignant change, but pain and swelling are the more common early complaints. The tumors are mostly of lytic variety, although a few may be of mixed or even sclerotic x-ray types. Rapid growth is observed in every instance. The borders are usually indistinct, with no periosteal reaction. Generally a soft-tissue mass is present. The shape is mostly oval and the diameter 2 to 4 inches. Usually there is no joint involvement. Some of the tumors are probably multicentric, but metastases to normal bone and to lung occur not infrequently.

DISCUSSION

For the prompt x-ray recognition of an osteogenic sarcoma developing in Paget's disease, good detail films are needed. The earliest sign is usually a small area of subcortical bone destruction with some cortical erosion (Fig. 10). Extension beyond the bone occurs relatively early. Special attention must be given to any pathological fracture occurring in Paget's disease. These fractures must be sufficiently well shown so that all chance of an accompanying osteogenic sarcoma can be reliably excluded (Fig. 11).

The problem of differential diagnosis for the radiologist would seem to be chiefly that of trying to determine the nature of the malignant tumor present. It must be pointed out that the osteogenic sarcomas seen in this material did show a uniformity of appearance not presented by a group of unselected, consecutive cases of osteogenic sarcoma in normal bone. Except for a few of the denser tumors, which in

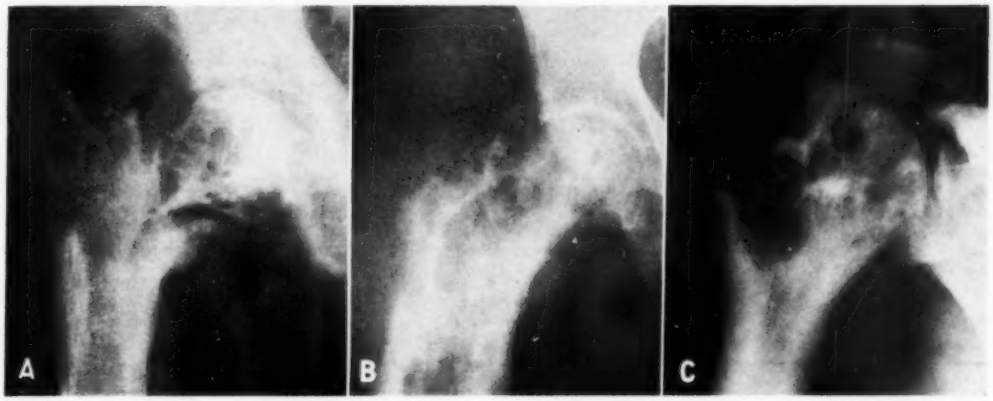


Fig. 12. A. Metastasis developing in Paget's disease. A 52-year-old man gave a history of pain for four months, with a limp and swelling of right upper thigh. X-ray examination showed an osteolytic lesion of the right femoral neck with pathological fracture. Aspiration biopsy revealed a metastatic lesion of renal-cell carcinoma origin.

B. Metastasis developing in Paget's disease. A 66-year old man had pain in the right hip and right sacroiliac joint for three years. X-ray examination showed Paget's disease of the right femur. The patient was followed for two years. Intestinal obstruction then developed, for which exploratory laparotomy was performed and adenocarcinoma of colon was found. Postmortem examination revealed metastasis to the right femur.

C. Metastasis developing in Paget's disease. A 67-year-old man gave a history of cough of seven months duration followed by pain in the right shoulder. Biopsy of a right supraclavicular node revealed metastasis of bronchogenic origin. Postmortem examination confirmed the diagnosis of bronchogenic carcinoma with metastasis to the right humerus.

themselves seemed fairly reliable for osteogenic sarcoma, the bulk of the osteogenic sarcomas were lytic. Furthermore, no periosteal or extraosseous forms of osteogenic sarcoma were seen. The absence of periosteal reaction was also one of the most interesting features of this sarcoma. These points emphasize a greater constancy in the roentgenographic appearance of osteogenic sarcoma developing in Paget's disease than for ordinary osteogenic sarcomas.

Unfortunately, in the osteogenic sarcoma developing in Paget's disease this predominant form fits into the roentgen picture that is often seen with metastases from different sources. In our experience, therefore, it would be impossible to differentiate reliably between cancer metastases and osteogenic sarcomas occurring in areas of Paget's disease, except possibly for the uncommon sclerotic form of osteogenic sarcoma. The similarity in roentgen appearance between certain cancer metastases in Paget's disease and the usual osteogenic sarcoma developing in Paget's disease is shown in the group of proved metastases shown in Figure 12.

SUMMARY AND CONCLUSIONS

1. Nineteen patients with 22 histologically proved osteogenic sarcomas developing in Paget's disease have been studied roentgenologically.

2. Osteogenic sarcoma in osteitis deformans shows a rather constant roentgen appearance, characterized by subcortical medullary bone destruction, cortical bone loss, a soft-tissue mass, and a lytic x-ray picture, with rapid growth.

3. The roentgen appearance is similar to certain cancer metastases in Paget's disease, and an absolute differentiation between these conditions cannot be made on roentgen findings alone.

4. Fractures occurring in Paget's disease must be well studied roentgenographically so that the presence of any osteogenic sarcoma can be readily recognized.

ADDENDUM

Since submission of the original material, 2 additional cases of osteogenic sarcoma developing in Paget's disease have been observed. Both were of the sclerosing type, one being in the pelvis and the other in the mandible. The findings were essen-

tially in keeping with those previously described. This brings the total to 21 patients with 24 sarcomas.

444 E. 68th St.
New York 21, N. Y.

REFERENCES

1. BIRD, C. E.: Sarcoma Complicating Paget's Disease of the Bone; Report of 9 Cases, 5 with Pathologic Verification. Arch. Surg. **14:** 1187–1208, June 1927.

2. BUTLER, F. E., AND WOOLLEY, I. M.: Osteogenic Sarcoma Arising from Calcified Hematoma. Radiology **26:** 236–237, February 1936.

3. CAHAN, W. G., AND OTHERS: Sarcoma Arising in Irradiated Bone. Report of 11 Cases. Cancer **1:** 3–29, May 1948.

4. COLEY, B. L., AND SHARP, C. S.: Paget's Disease. A Predisposing Factor to Osteogenic Sarcoma. Arch. Surg. **23:** 918–936, December 1931.

5. COLEY, B. L., AND STEWART, F. W.: Bone Sarcoma in Polyostotic Fibrous Dysplasia. Ann. Surg. **121:** 872–881, June 1945.

6. DA COSTA, J. C., FUNK, E. H., BERGEIM, O., AND HAWK, P. B.: Osteitis Deformans. Publications Jefferson Medical College and Hospital **6:** 1–44, 1915.

7. DAVIE, T. B., AND COOKE, W. E.: The Supervention of Osteogenic Sarcoma in Paget's Disease. Brit. J. Surg. **25:** 299–316, October 1937.

8. FOOTE, F. W.: Personal Communication.

9. GESCHICKTER, C. F., AND COPELAND, M. M.: Tumors of Bone. Philadelphia, J. B. Lippincott Co., 3d ed., 1949.

10. GRUNER, O. C., SCRINGER, F. A.C., AND FOSTER, L. S.: A Clinical and Histological Study of a Case of Paget's Disease of the Bones with Multiple Sarcoma Formation. Arch. Int. Med. **9:** 641–656, June 1912.

11. HATCHER, C. H.: Development of Sarcoma in Bone Subjected to Roentgen or Radium Irradiation. J. Bone & Joint Surg. **27:** 179–195, April 1945.

12. MARTLAND, H. S.: Occurrence of Malignancy in Radioactive Persons: A General Review of Data Gathered in the Study of the Radium Dail Painters, with Special Reference to the Occurrence of Osteogenic Sarcoma and the Inter-Relationship of Certain Blood Diseases. Am. J. Cancer **15:** 2435–2516, October 1931.

13. O'REILLY, T. J., AND RACE, J.: Osteitis Deformans. Quart. J. Med. **1:** 471–497, October 1932.

14. PACK, G. T., AND BRAND, R. R.: The Development of Sarcoma in Myositis Ossificans. Report of 3 Cases. J.A.M.A. **119:** 776–779, July 4, 1942.

15. PACKARD, F. A., STEELE, J. D., AND KIRKBRIDE, T. S., JR.: Osteitis Deformans. Am. J. M. Sc. **122:** 552–569, November 1901.

16. PAGET, J.: Remarks on Osteitis Deformans. Illus. M. News. **2:** 181–183, 1889.

17. SEAR, H. R.: Some Notes on Diagnosis of Bone Tumors. Brit. M. J. **1:** 49–53, Jan. 11, 1936.

18. SEAR, H. R.: Osteogenic Sarcoma as a Complication of Osteitis Deformans. Brit. J. Radiol. **22:** 580–587, October 1949.

19. SNAPPER, I.: Medical Clinics on Bone Diseases. A Text and Atlas, New York, Interscience Publishers, Inc., 2d ed., 1949.

20. SUMMEY, T. J., AND PRESSLY, C. L.: Sarcoma Complicating Paget's Disease of Bone. Ann. Surg. **123:** 135–153, January 1946.

SUMARIO

Estudio Roentgenológico del Sarcoma Osteógeno Aparecido en la Enfermedad de Paget

Este estudio roentgenográfico comprende a 19 enfermos con sarcoma osteógeno comprobado histológicamente y aparecido en la enfermedad de Paget. La enfermedad de Paget correspondía a la habitual forma roentgenológica en contraposición a las menos frecuentes formas osteoporótica y esclerótica. El sarcoma apareció casi siempre en forma de una zona de destrucción ósea, subcortical en su ubicación al principio, con subsiguiente destrucción cortical. A veces una fractura patológica o tumefacción pulsátil constituye el primer signo clínico de alteración maligna en la enfermedad de Paget, pero el dolor y el edema son síntomas más comunes. Los tumores son en su mayoría de la variedad lítica. Pertenecen a esa clase 14 de los de esta serie, en tanto que 1 fué esclerótico y 7 eran de forma mixta. El desarrollo es rápido. Por lo general, existe una tumefacción de tejido blando. La invasión articular es rara.

El aspecto roentgenológico es semejante al de ciertas metástasis cancerosas y a base exclusiva de las radiografías la diferenciación absoluta resulta imposible.

Las fracturas observadas en la evolución de la enfermedad de Paget deben ser investigadas en el acto radiográficamente, de modo que pueda reconocerse sin tardanza la presencia de sarcoma osteógeno.

Congenital Coxa Vara

Osteochondrodysplasia of the Femoral Neck[1]

JOHN M. CLARK, M.D., and GEORGE JACOBSON, M.D.

CONGENITAL COXA VARA is a deformity of the hip caused by an osteochondrodysplasia of the femoral neck and usually characterized by distinctive roentgenographic changes. Because of its infrequent occurrence, this condition is often mistaken for a variety of other diseases, and proper treatment is needlessly delayed or withheld. Early corrective surgery is almost always followed by a good result; whereas other measures frequently lead to increasing deformity.

The literature concerning congenital coxa vara was reviewed by Zadek in 1935 (13). Relatively few articles have appeared on the subject since that time, although there have been several reports in the last five years (2, 7, 9, 10, 11).

ETIOLOGY

The etiology of congenital coxa vara has never been definitely established. The deformity is the result of osteochondrodysplasia of the femoral neck. Cases have been reported in identical twins (2) and also in siblings (5). The occurrence of the process as a solitary lesion tends to exclude a generalized metabolic disorder, such as rickets, as an etiologic factor.

PATHOLOGY

Under normal conditions, the femoral neck develops as an upward and medial growth of the diaphysis. Fusion of the epiphysis occurs between seventeen and nineteen years of age. A diaphyseal spur grows medially under the femoral head, causing the epiphyseal plate to become horizontal, supporting the head from below.

In congenital coxa vara the cartilage of this spur does not ossify normally, and a more vertical epiphyseal plate results (Fig. 1). A cartilaginous plate is often seen extending into the metaphysis, giving rise to the formation of a separate bone fragment (Fig. 4). This fragment of bone corresponds to the normal supporting ledge for the femoral capital epiphysis. Rather than actually originating from the metaphysis, it is possible that this fragment represents a separate ossification center. Occasionally an irregular mixture of bone fragments, cartilage, and fibrous tissue is found in the metaphysis beneath the deformed epiphyseal plate. The capital epiphysis is displaced downward in relation to the trochanters, but retains its normal shape. The shearing forces concomitant with weight-bearing act upon the deformed femoral neck to produce coxa vara.

Barr (3) removed material from the midcervical region of the femur. Histologically, it showed abnormal enchondral ossification, islands of disintegrated cartilage, and some bone atrophy. "Nowhere was there marked evidence of bone formation, nor was there evidence of repair."

Delitala (4), as quoted by Zadek (13), reported in 1913: "What must be considered as the principal fact shown by the histologic finding, it seems to me, is the anomalous constitution of the conjugate cartilage, with which are connected the altered direction of the line of ossification, the slowness of the bone transformation, and the irregularity of form and arrangement of the spongy trabeculae; they are all facts which together account for the deformity of the neck of the femur and which I shall call dystrophic."

The microscopic sections from one of Zadek's cases were reviewed by Dr. H. L. Jaffe: "Section of the larger piece,

[1] From the Department of Radiology, School of Medicine, University of Southern California, and the Los Angeles County Hospital, Los Angeles, Calif. Accepted for publication in July 1953.

Fig. 1. Case 1: E. B., white male, aged 3. Admitted to the hospital immediately following an automobile accident. Previously asymptomatic. No limp. Limitation of external rotation and abduction of the right hip.
Roentgen Examination: Slight coxa vara deformity of the right hip with shortening of the femoral neck.

which revealed the articular cartilage, showed degenerative phenomena in the deeper layers of the cartilage with areas suggestive of mucinous degeneration and also the appearance of tiny intracartilaginous cysts, apparently on the basis of liquefaction of the cartilage. The subchondral bone was compact, there being widespread subchondral osteosclerosis, which extended through the entire capital epiphysis from the area from which the section was taken. Between the thick trabeculae there was a rather loose connective tissue containing vessels, osteoblasts on the surfaces of the canals, and, in places, osteoclasts. Between the thick trabeculae, areas of marrow were observed; in some regions the marrow showed an increase in the connective tissue stroma and also slight evidence, in places, of connective tissue bone formation. What was observed of the epiphyseal cartilage plate was extremely difficult to interpret, since it was at the edge of the section, the surgical specimen apparently passing through areas of the plate. The epiphyseal cartilage plate showed changes which might be interpreted as evidence of beginning closure. These changes extended down toward the neck, where the bone was sclerotic. An occasional islet of included epiphyseal cartilage plate was observed within the substance of the bone."

SYMPTOMS

Painless limp is the earliest sympton of congenital coxa vara. The limp usually makes its appearance between the ages of four and twelve years, which is a period of rapid growth. As the disease pro-

Fig. 2. Case 2: R. R., white male, aged 7. Painless limp for three months. Left leg 2 cm. shorter than right. Additional gluteal folds on the left. No limitation of motion. Pain elicited by flexion or external rotation of the left hip.
Roentgen Examination: Marked coxa vara. Femoral neck shortened and fragmented. Femoral head demineralized but otherwise normal.

gresses, there is shortening of the leg, with limitation of abduction and rotation. When the patient stands on the affected limb and lifts the opposite foot from the floor, the unaffected hip descends instead of rising (Trendelenburg test). The greater trochanter is almost always above a line from the anterior-superior process of the ilium to the most prominent part of the tuberosity of the ischium (Nelaton's line).

A waddling gait and increased lumbar lordosis resembling congenital dislocation of the hip occur in patients who have bilateral involvement. On examination, the femoral head is found to be in a normal position and dislocation cannot be produced by alternate traction and pressure. Pain occurs in advanced stages of the disease, when the greater trochanter impinges on the rim of the acetabulum.

Fig. 3. Case 3: V. C., white female, first seen in 1929 at age 5. Painless limp and shortening of right leg. Elevation of the greater trochanter of the right femur.
Roentgen Examination: A. Age 5. Moderate coxa vara. Marked shortening of the femoral neck. The triangular bone fragment (arrow) results from extension of the epiphyseal cartilage into the metaphysis. B. Age 9. Increasing deformity. C. Age 13. Extreme coxa vara. Marked femoral shortening. Femoral head fused to the femoral neck at the level of the lesser trochanter.

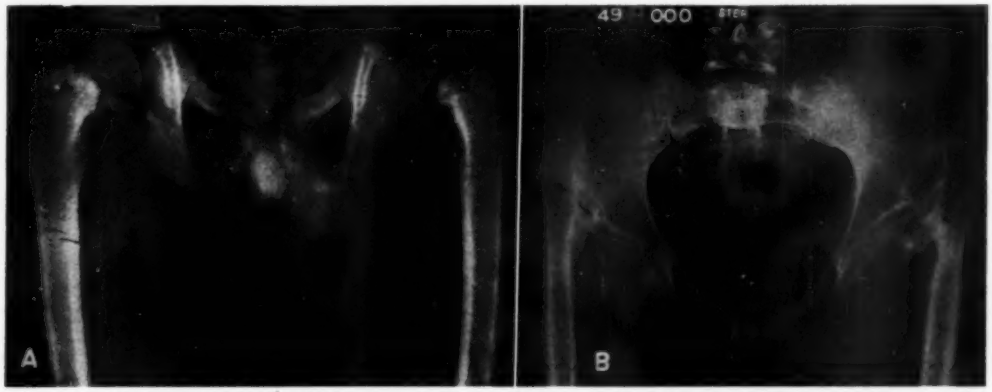


Fig. 4. Case 4: D. G., white male, first seen at the age of 4 years with painless limp and waddling gait. (Courtesy of Homer Graham, M.D., Burbank, Calif.)
Roentgen Examination: A. Age 4. Note the triangular metaphyseal bone fragments bilaterally. B. Age 28. The right femur is displaced upward, forming a pseudarthrosis with the ilium. The demineralized femoral head remains in the acetabulum. The deformity of the left hip is less marked; the femoral head is incompletely fused with the femur.

ROENTGEN MANIFESTATIONS

Coxa vara of varying degree is present in most cases of osteochondrodysplasia of the femoral neck and is the most readily discernible manifestation of the disease. The epiphyseal cartilaginous plate assumes a more vertical position than is normal (Fig. 1). The femoral neck adjacent to the epiphyseal plate is frequently fragmented (Fig. 2). Characteristically, a triangular fragment of bone, corresponding to the inferior medial portion of the femoral metaphysis, is seen just beneath the capital femoral epiphysis (Figs. 2–6).

As the deformity progresses, the greater trochanter becomes elevated and frequently has a pointed or beaked appearance. The femoral neck is shortened or may be completely absent. Fusion of the femoral head occurs at the level of the lesser trochanter (Figs. 3 and 4). In advanced stages, prolonged impingement of the greater trochanter against the wing of the ilium may produce a pseudarthrosis. In such cases, the femoral head remains in the acetabulum and is completely separate from the femoral neck (Fig. 4).

DIFFERENTIAL DIAGNOSIS

Osteochondrodystrophy of the femoral

Fig. 5. Case 5: J. D., white female, first seen at the age of 3 years with painless limp. (Courtesy of Harold Cole, M.D., Pomona, Calif.)
Roentgen Examination: A. Age 3. Separate triangular metaphyseal bone fragment without coxa vara. B. Age 8. Moderate coxa vara. The femoral neck is short and broad. Metaphyseal margin irregular.

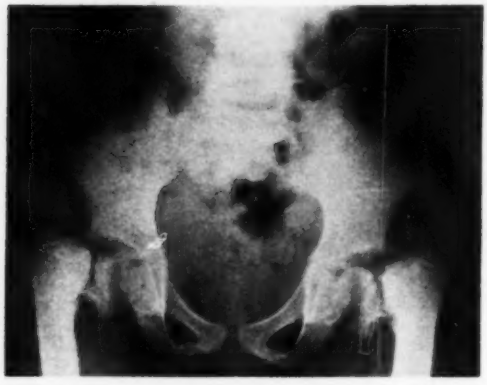


Fig. 6. Case 6: G. W., Negro male, age 8. Normal delivery in 1945. No injury or abnormality noted at birth. Asymptomatic until age of 3, when intermittent bilateral hip pain and limp developed. There was limitation of abduction and external rotation of both hips with slight atrophy of the thighs.
Roentgen Examination: Marked bilateral coxa vara. Both femoral necks shortened and sclerotic. Slight fragmentation of the metaphysis.

neck may be distinguished from other conditions roentgenologically. Fracture of the femoral neck is a rarity in children and would not produce alterations in the angle of the epiphyseal plate or the deformity of the femoral neck and trochanter. Legg-Perthes' disease may be excluded by the absence of radiologic evidence of aseptic necrosis of the capital femoral epiphysis. With slipped femoral epiphysis, extension of epiphyseal cartilage into the proximal femoral metaphysis does not occur. Rickets has not been convincingly implicated in any of the cases, and there is no response to vitamin D therapy. Congenital dislocation of the hip is primarily a disease of the acetabulum and produces rather characteristic changes. Coxa vara following tuberculosis, osteomyelitis, metastatic or localized neoplasm, etc., is accompanied by the usual signs of these diseases and is not likely to be confused with congenital coxa vara.

PROGNOSIS AND TREATMENT

It is reasonable to suppose that a certain number of subclinical cases of congenital coxa vara undergo spontaneous cure without residual deformity. Disease severe enough to produce clinical symptoms usually results in progressive deformity unless adequate treatment is instituted.

Recent reports indicate that subtrochanteric wedge osteotomy is the preferred method of treatment (2, 7, 8, 9, 11, 12). The purpose of this operation is to prevent the shearing and distracting stresses on the cartilaginous neck by over-correcting the varus deformity. This also encourages early ossification and increases the length of the femur. Most authors agree that surgical reconstruction of the femoral neck is harmful (12; 13); some

recommend the use of intramedullary pins to strengthen the neck (3, 11), and others feel that these pins are not justified (9). If the patient refuses surgery, the prevention of weight-bearing by the use of a lift under the sound leg and the aid of crutches is recommended (7). Braces and casts are to be condemned (7, 13), although postoperative skeletal traction is advised in unilateral cases (12). Following subtrochanteric osteotomy, almost all reported cases have gone on to osseous union and in none has pseudarthrosis developed (2, 7, 8, 9, 11, 12).

SUMMARY

Congenital coxa vara is a deformity of the hip caused by osteochondrodysplasia of the femoral neck. Diagnosis is easily established by the roentgen appearance. Proper early treatment leads to uniformly good results, whereas untreated cases often progress to crippling deformities.

1200 N. State St.
Los Angeles 33, Calif.

REFERENCES

1. ARMSTRONG, J. R.: A Case of Infantile Coxa Vara, with Notes on Aetiology. Lancet **1**: 1498–1500, June 29, 1935.
2. BABB, F. S., GHORMLEY, R. K., AND CHATTERTON, C. C.: Congenital Coxa Vara. J. Bone & Joint Surg. **31-A**: 115–131, January 1949.
3. BARR, J. S.: Congenital Coxa Vara. Arch. Surg. **18**: 1909–1919, April 1929.
4. DELITALA, F.: Sulla coxa vara congenita. Arch. di ortop. **30**: 382–396, 1913.
5. FRANCKE: Case Reports on Congenital Coxa Vara. Ztschr. f. orthop. Chir. **15**: 288–293, 1906.
6. GOLDING, F. C.: Congenital Coxa Vara. J. Bone & Joint Surg. **30-B**: 161–163, February 1948.
7. HARK, F. W.: Congenital Coxa Vara. Am. J. Surg. **80**: 305–310, September 1950.
8. HEUBLEIN, G. W., BERNSTEIN, L., AND HUBENET, B. J.: Hip Lesions of Infants and Children Seen at the Newington Home and Hospital for Crippled Children (Newington, Conn.). Radiology **51**: 611–646, November 1948.
9. HORWITZ, T.: Treatment of Congenital (or Developmental) Coxa Vara. Surg., Gynec. & Obst. **87**: 71–75, July 1948.
10. JOHANNING, K.: Coxa Vara Infantum, I. Clinical Appearance and Aetiological Problems. Acta orthop. Scandinav. **21**: 273–297, 1951.
11. LE MESURIER, A. B.: Developmental Coxa Vara. J. Bone & Joint Surg. **30-B**: 595–605, November 1948.
12. ROBERTS, W. M.: End Result Study of Congenital Coxa Vara; Treated by Haas Trochanteric Osteotomy. South M. J. **43**: 389–392, May 1950.
13. ZADEK, I.: Congenital Coxa Vara. Arch. Surg. **30**: 62–102, January 1935.

SUMARIO

Coxa Vara Congénita. Osteocondrodisplasia del Cuello del Fémur

La coxa vara congénita es una deformidad de la cadera ocasionada por la osteocondrodisplasia del cuello del fémur. Tradúcese primero por claudicación indolora que aparece a la edad de cuatro a doce años, que es un período de rápido desarrollo. Más tarde, sobreviene acortamiento de la pierna con limitación de la abducción y la rotación. El diagnóstico se establece con facilidad roentgenográficamente. La lámina cartilaginosa de la epífisis ocupa una posición más vertical que la normal y el adyacente cuello femoral se halla frecuentemente fragmentado. Típicamente, se observa un fragmento triangular separado de hueso precisamente debajo de la epífisis de la cabeza femoral. Al avanzar la deformidad, se acorta el cuello del fémur y tiene lugar la fusión de la cabeza del hueso al nivel del trocánter menor.

El tratamiento temprano conduce a resultados uniformemente buenos, mientras que los casos no tratados pueden agravarse hasta producir deformidades incapacitantes. Comunicaciones recientes indican que la osteotomía en cuña subtrocantérica es el procedimiento de elección.

Bone and Joint Changes in Hemophilia

A Long-Term Study in Twelve Negro Subjects[1]

JOHN B. JOHNSON, M.D., T. WILKINS DAVIS, M.D., and WILLIAM H. BULLOCK, M.D.

BONE AND JOINT changes are among the most common manifestations of hemophilia. In their absence one is inclined to question the diagnosis in adult life. Roentgenologically, these changes are varied and relatively non-specific, depending to a large extent on the frequency of hemarthroses, the joints involved, and the age of the patient.

During the past eight years we have had the opportunity of studying a group of hemophiliacs of various ages. In several instances x-ray examinations of involved joints were made initially prior to epiphyseal closure and periodically thereafter for several years. Thus a record of the progression of the bone and joint changes has been obtained. In addition to the serial changes, a variety of joint lesions ranging from minimal to far advanced are demonstrated in this group of patients.

CLINICAL AND RADIOLOGICAL DATA

Twelve cases are presented here, representing 6 families (Table I). The first 5 cases have been under observation since 1945. Cases 6 through 9, from the third family, were seen in 1949. The last 3 cases, from unrelated families, were seen in 1952. In all of these cases the following laboratory criteria have been met: prolonged coagulation time of blood; positive Quick test; normal prothrombin, bleeding and clot retraction times. In 8 of the cases the prothrombin consumption was determined and found to be poor. The other 4 patients were studied prior to the development of prothrombin consumption determinations. The whole blood coagulation time in these subjects was as shown in the accompanying table.

The details of the clinical course, laboratory data, and genealogical history are reported elsewhere (1).

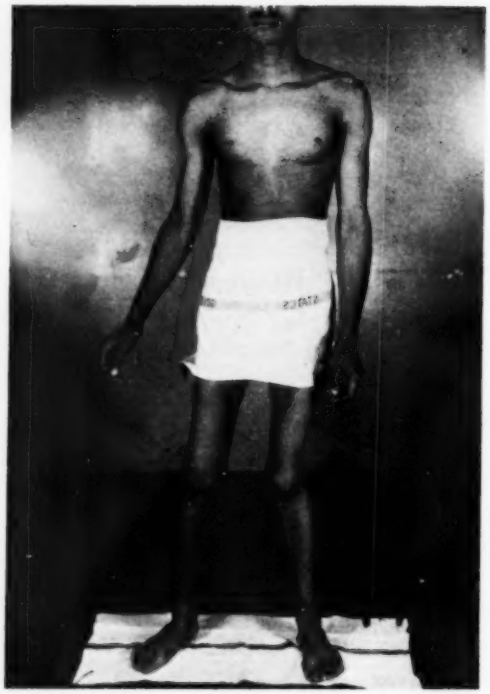


Fig. 1. T. McC. Left genu valgum, with posterior displacement of tibia; reduced carrying angle of left elbow.

Subject	*Age*	*Coagulation Time (minutes)*
Controls	...	9–12
First family		
1. T. McC.	23	74
2. D. McC.	19	118
3. H. McC.	21	112
Second family		
4. J. H.	22	43
5. Jas. H.	18	47
Third family		
6. T. W.	26	42.5
7. N. W.	28	38
8. C. W.	33	33.5
9. G. N.	43	17.5
Fourth, fifth and sixth families		
10. R. L.	15	66
11. R. T.	7	30
12. H. L.	4	45

[1] From the Divisions of Internal Medicine and Radiology, Department of Medicine, Freedmen's Hospital and Howard University, Washington, D. C. Accepted for publication in July 1953.

In the first family (McC.) there are 3 known hemophiliacs, the only children of their parents. Figure 1 shows the physical appearance of one of these brothers (T. McC.). Note the presence of genu valgum on the left, with posterior displacement of the tibia, associated with general atrophy of the left lower extremity. The carrying angle of the left elbow is reduced.

The x-ray changes in this subject are of moderate severity. Figure 2 shows the right elbow, with enlargement and flaring of the radial head. Small rounded radiolucent defects are seen along its articular margin and along the lateral epicondyles of the humerus, indicative of cystic dissolutions.

Figure 3 (1944) shows bulging of the synovium and slight widening of the joint space due to a massive hemarthrosis in the right knee. The intercondylar fossa is slightly wider than normal, but the articular margins are smooth. Small ill-defined rarefactions are present in the subarticular portion of the tibial epiphysis, suggesting early cyst formation. During a seven-year period, x-ray studies of this knee have disclosed progressive changes. Figure 4 (1951) shows increased widening and deepening of the intercondylar fossa, decreased joint space with irregularity of articular surfaces, and slightly increased cystic changes. X-ray studies of the left knee (not reproduced here) demonstrate marked anterior tilting of the proximal end of the tibia, which on physical examination simulated subluxation.

Fig. 2. T. McC. Right elbow, showing enlarged flaring radial head and cystic changes in the lateral humeral epicondyle.

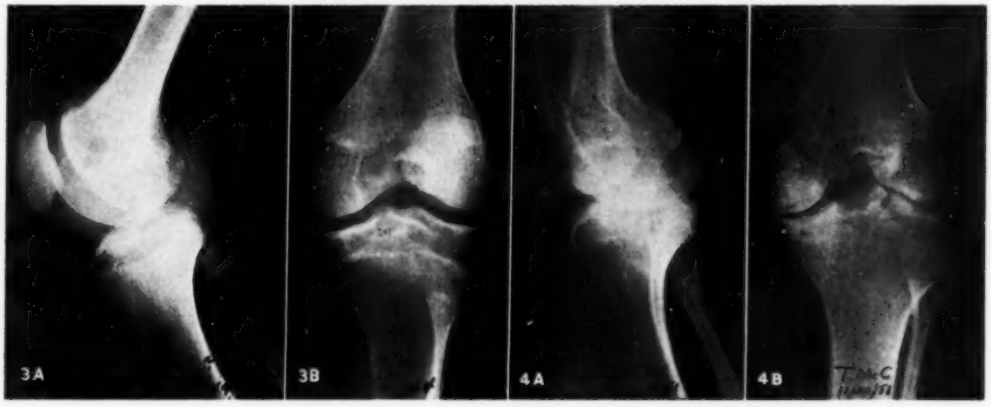


Fig. 3. T. McC. Right knee in 1944, showing widened joint space and bulging of the synovium due to massive hemarthrosis.

Fig. 4. T. McC. Right knee in 1951. Note further decrease in joint space, increase in bone destruction, and progressive widening and deepening of intercondylar fossa.

The second brother, D. McC., on physical examination was found to have some limitation in extension of the right

Fig. 5. D. McC. Right elbow in 1945, showing flaring deformity of radial head associated with cystic changes along its articular surfaces; premature closure of epiphyses of radial head and olecranon process.
Fig. 6. D. McC. Right elbow in 1951. Note persistent deformity of radial head and humeral epicondyles but disappearance of cystic changes.

elbow. The right lower extremity was somewhat atrophic, with limitation of extension of the knee to 170°. There was elevation of the wing of the right pelvis, and the pelvis was rotated anteriorly. The roentgen changes in the right knee were similar to those in T. McC. (Figs. 3 and 4). X-ray studies of the right elbow over a five year period are shown in Figures 5 (1945) and 6 (1951). These are of particular interest in that there appears to be some improvement in the later films.

Figure 5 (1945) demonstrates a characteristic flaring deformity of the radial head associated with ill-defined shadows of decreased density along its articular surface and in the adjacent portion of the lateral humeral epicondyle, which are suggestive of cystic changes. The epiphyses for the radial head and olecranon process are prematurely fused. Six years later (1951) the radial head retains its characteristic deformity (Fig. 6). Its articular surfaces and those of the lateral humeral epicondyle are distinct and smooth. The apparent cystic changes previously identified have disappeared.

Roentgenograms (not reproduced here) of the left knee of the third brother, H. McC., show rather marked cystic changes.

In the second family (H.) there were 6 children, of whom one was a girl. Three of the five boys have shown a life-long tendency to hemorrhage. Two of the 3 are included in our study.

In the first patient, Jas. H., x-ray studies of both knees showed early mild nonspecific changes including slight coarsening and demineralization of the trabecular pattern, arrested growth lines, and premature closure of a femoral epiphysis (left). In the right knee, in addition, there was characteristic widening of the intercondylar fossa (Fig. 7A). Roentgenograms of this knee obtained six months later (Fig. 7B) show small circumscribed rarefactions at the base of the lateral tibial spine and in the proximal fibular epiphysis. In the interval 1947 to 1952 a slight decrease in the coarsening of the trabeculae occurred (Fig. 7C), and there was normal closure of the epiphyses. The growth lines likewise became less distinct. While there has been an unquestionable slight improvement in the texture of the bones, the contour of the intercondylar fossa remains unchanged. The lack of progression in these lesions is noteworthy.

X-ray studies of knees and elbows of the brother, J. H., revealed enlargement and deformity of the epicondyles of the right humerus. The right knee showed changes

Fig. 7. Jas. H. Left knee showing serial changes during an interval of five and a half years. Note the characteristic widening and deepening of the intercondylar fossa and the coarsening of the trabeculae. A. April 1947. B. October 1947. C. November 1952.

practically identical with those in the left knee of the brother (Fig. 7B), except that, in addition, the epiphyses were prematurely fused.

In the third family, there were 4 cases which came under our direct observation. Two of the patients were brothers, the others were first cousins. In this family there was a typical genealogical pattern, and other remote cousins displayed a bleeding tendency.

X-ray studies of the right elbow of N. W. demonstrated a localized slight thickening of the cortex on the lower medial aspect of the humerus, evidently due to calcification of an old subperiosteal hemorrhage. In the knees there were moderately advanced changes very similar to those in T. McC. (Fig. 4). The alterations were a little more advanced in the right knee, where there was slight anterior angulation of the upper end of the tibia clinically simulating a minor subluxation.

The right elbow of C. W. is shown in Figure 8. The conspicuous changes are the multiple small to moderate-sized,

Fig. 8. C. W. Right elbow showing numerous small to moderate-sized cystic changes.

somewhat circumscribed cystic defects in the lower end of the humerus adjacent to its articular surface. In Figure 9 roentgenograms of the left knee of this patient are reproduced. Observe the giant cyst formation in the upper end of the tibia. In the lateral projection, a thin, curvilinear

radiopacity is identified on the anterior superior aspect of the joint (arrow). Its position is approximately at the outer margin of the synovium, and it may represent an area of calcification within that membrane. Within the limits of the synovium, particularly on the anterior, posterior, and lateral aspects of the joint, are faint, ill-defined somewhat lobulated shadows of increased density. These shadows have been described by some authors as organized blood clots. There is a good possibility that they may represent condensation of iron pigment in the periarticular soft tissues as a result of repeated hemorrhages.

G. N. is the oldest patient in the series and his roentgenograms show the most advanced joint changes. In the left knee (Fig. 10) there is marked reduction of the joint space associated with marginal spur formation and sclerosis along the articular surfaces. Cyst formation is only moderate. Roentgenograms of the right ankle (not shown here) reveal, in addition, a bony ankylosis involving the anterior portion of the tibio-astragalar joint. In contradistinction to the pronounced cystic changes in C. W. (Figs. 8 and 9), a cousin, the predominant feature in this case is sclerosis.

R. L. (aged fifteen), R. T. (seven), and H. L. (four) showed no significant roentgen changes.

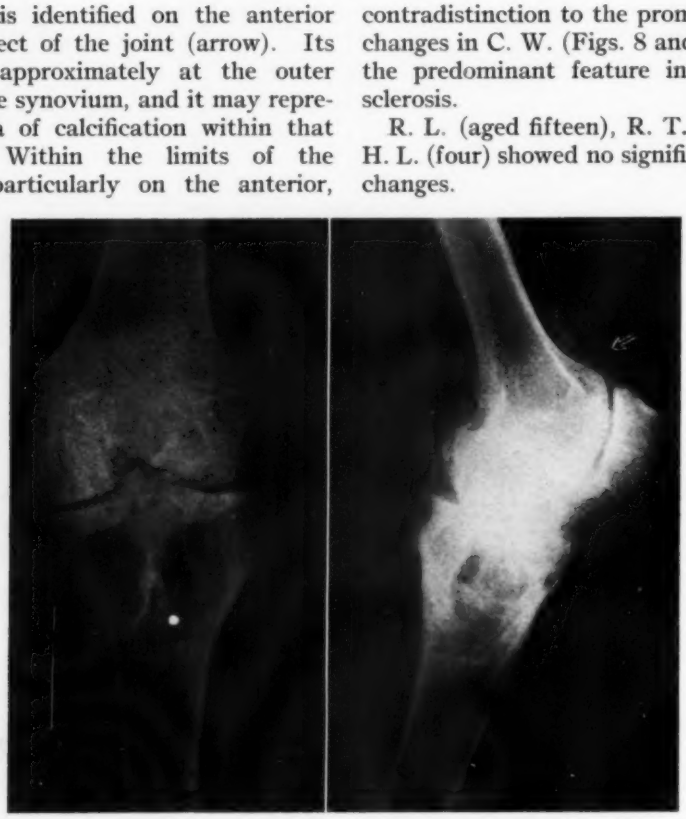


Fig. 9. C. W. Left knee displaying giant cystic formation.

DISCUSSION

The bone and joint changes in hemophilia in general are the result of decalcification, compression atrophy from hemorrhage, calcium and iron deposition, and fibrous tissue formation with ankylosis. An excellent demonstration and discussion of the histopathology, particularly in the synovium, have been presented by Key (3). Keefer and Myers (2) summarized the joint changes which have been demonstrated by x-ray examination.

For convenience of discussion, we have divided the roentgen findings into three stages: early, moderately advanced, and advanced. The earliest joint changes are incident to acute hemarthrosis resulting in a swollen, exquisitely tender joint with or without local heat and usually without discoloration of the skin. In this stage,

the x-ray findings are slight and nonspecific. There is obvious swelling; there may or may not be distention of the joint space, and the soft tissues show increased density. In some instances, evidence of subperiosteal hemorrhage is visible, but most often bony alterations are absent.

Fig. 10. G. N. Advanced arthritic changes in left knee. The prominent feature is subcortical sclerosis rather than cystic change.

This stage is illustrated by cases T. McC. (Fig. 3) and Jas. H. (Fig. 7A).

The moderately advanced stage is the result of chronic irritation from repeated hemorrhages into the joint and is characterized by thickening of the periarticular tissues; hypertrophy of the synovial membrane; erosion of the articular surfaces of the bone and cartilage; irregularity of the joint space, which may show slight narrowing; widening and deepening of the intercondylar fossa, and early subchondral and intraosseous cystic formation (Fig. 4).

The advanced stage exhibits marked diminution or even absence of the joint space, pronounced subchondral and intraosseous cystic formation, subluxation, and ankylosis. These joints likewise almost invariably reveal marginal spurring and sclerosis of the juxta-articular margins (Figs. 9 and 10).

In the series of cases reported here, the knee joint was most frequently involved, followed by the elbow and ankle joints. This sequence is in keeping with that reported by McDonald and Lozner (4). Thomas (5), however, in reporting 98 cases, gives the following sequence: knees, ankles, elbows, hips, and smaller joints, the shoulder escaping permanent damage more often than any other joint. In general, the degree of involvement increases proportionately with the chronological age. The oldest patient in our series displays the most advanced bony alterations. Our experience is in agreement with that of others (4), that bony ankylosis is an unusual finding in hemophilic arthritic joints. Contrary to the opinion of Freund (6), it does occur, as shown in our case G. N.

Cystic changes are a striking development in some cases, but for unexplained reasons do not appear in others equally severe. It should also be noted that both

the knee and elbow joints may manifest this change, suggesting that, when it is a prominent feature, other joints may show similar alterations.

Several cases in our series showed premature closure of the epiphyses about the elbow and knee joints. The effect of hemophilia on the epiphyses has been discussed by a number of authors (7, 8, 9). Caffey and Schlesinger (10), in a detailed discussion of this subject, expressed the opinion that acceleration of development and overgrowth are due to excessive effusion of blood into the growing epiphyses over periods of several months or years.

The question often arises as to whether one can make a diagnosis of hemophilic arthritis from the roentgen signs alone. Doub and Davidson (11) stated that a diagnosis of hemophilic arthritis can be made without clinical data in the advanced cases which present general or localized cartilaginous destruction, with typical punched-out areas of destruction within the bones, especially when they are seen in conjunction with organized blood clot in the synovial cavity. Key (12) stated that those cases which show greatly increased density of the synovial tissues and crater-like depressions or punched-out defects on the articular surface of bones can be diagnosed roentgenographically. He indicated, however, that in the majority of cases these characteristic features may not be present and a diagnosis cannot be made by x-ray examination alone. Klason (8) and Rypins (13) were of the opinion that widening and deepening of the intercondylar fossa in a member of the male sex are characteristic of hemophilia.

Possibly without exception, it is agreed that diagnosis of hemophilic arthritis in the acute or early stage is almost impossible by x-ray examination alone, while in the more advanced stages differential diagnosis may frequently be possible. The later stages of the disease must be differentiated from hypertrophic, rheumatoid, gouty, and tuberculous arthritides. Hypertrophic arthritis is common in late adult life and rarely occurs before forty years of age. In hemophilia, bone and joint changes almost always occur before the age of twenty-one. Periarticular swelling and thickening of the synovium, while pronounced in hemophilic arthritis, are usually slight or absent in hypertrophic arthritis. Cystic formations may be present in both conditions but are more numerous and more frequently seen in hemophilia.

The following features characteristic of rheumatoid arthritis may serve to differentiate that disease from hemophilic arthritis: marked atrophy without manifestations of bone production; frequent bony ankylosis; frequent involvement of the phalanges and spine. Gouty arthritis seldom presents a difficult problem of differentiation, since it affects primarily the periarticular tissues, usually involving the smaller joints, especially the great toe. Tuberculous arthritis, on the other hand, may constitute a serious problem. The character of the bone destruction, however, differs from that in hemophilic arthritis in that it is least intense in the portions of the joint subject to most intimate contact.

Widening and deepening of the intercondylar fossa are seldom if ever seen in any of the arthritides to be differentiated. In the advanced cases of our series, this feature was the most constant radiographic finding. It was not progressive in all the cases, nor was it particularly related to to the severity of the disease. The punched-out or cystic dissolutions were the second most frequent abnormality encountered. In view of these facts, we are in accord with the opinions of Key (12), Klason (8) and Rypins (13) that, when these changes are present in a member of the male sex, a roentgen diagnosis of hemophilic arthritis should be the first consideration.

Howard University
Washington 1, D. C.

REFERENCES

1. BULLOCK, W. H., JOHNSON, J. B., AND DAVIS, T. W. To be published.
2. KEEFER, C. S., AND MYERS, W. K.: Hemophilic Arthritis. New England J. Med. **208:** 1183-1189, June 8, 1933.

3. KEY, J. A.: Experimental Arthritis. The Reactions of Joints to Mild Irritants. J. Bone & Joint Surg. **11**: 705–738, October 1929.

4. MCDONALD, E. J., AND LOZNER, E. L.: Hemophilic Arthritis. Roentgenographic Studies in Fifteen Adult Patients with Hemophilia. Am. J. Roentgenol. **49**: 405–408, March 1943.

5. THOMAS, H. B.: Some Orthopaedic Findings in Ninety-Eight Cases of Hemophilia. J. Bone & Joint Surg. **18**: 140–147, January 1936.

6. FREUND, E.: Cited by Keefer and Myers.

7. FERGUSON, A. B.: Roentgen Diagnosis of Extremities and Spine. New York, Paul B. Hoeber, 1939.

8. KLASON, T.: Hemophilia and Hemophilic Arthropathy. Acta radiol. **1**: 26, 1922.

9. BRAILSFORD, J. F.: The Radiology of Bones and Joints. London, J. H. Churchill, 2d ed., 1935.

10. CAFFEY, J., AND SCHLESINGER, E. R.: Certain Effects of Hemophilia on Growing Skeleton. Some Roentgenographic Observations on Overgrowth and Dysgenesis of Epiphyses Associated with Hemarthrosis. J. Pediat. **16**: 549–565, May 1940.

11. DOUB, H. P., AND DAVIDSON, E. C.: Roentgen-Ray Examination of the Joints of Hemophilics. Radiology **6**: 217–227, March 1926.

12. KEY, J. A.: Hemophilic Arthritis. (Bleeders' Joints.) Ann. Surg. **95**: 198–225, February 1932.

13. RYPINS, E. L.: Roentgen Ray as an Aid in Diagnosis of Hemophilia. Am. J. Roentgenol. **31**: 597–602, May 1934.

14. DE LORIMIER, A. A.: The Arthropathies—A Handbook of Roentgen Diagnosis. Chicago, The Year Book Publishers, Inc., 1943, p. 123.

SUMARIO

Alteraciones Oseas y Articulares en la Hemofilia. Estudio a Largo Plazo en Doce Subjetos de Raza Negra

Estas observaciones versan sobre 12 hemofilíacos de raza negra, prestando en particular atención a las alteraciones en los huesos y las articulaciones. En varios casos se hicieron exámenes roentgenológicos de las articulaciones afectadas antes del cierre de las epífisis y periódicamente después por espacio de varios años. Figuran en la serie 3 hermanos de una familia, 2 de otra y 2 hermanos y 2 primos hermanos de otra familia más.

Las alteraciones roentgenológicas corresponden a tres períodos: temprano, moderadamente avanzado y avanzado. Las alteraciones articulares más tempranas se enlazan con la hemartrosis aguda y sus manifestaciones roentgenológicas son ligeras y anespecíficas. La etapa moderadamente avanzada representa la consecuencia de la irritación crónica derivada de las hemorragias repetidas y se caracteriza por espesamiento de los tejidos periarticulares; hipertrofia de la membrana sinovial; erosión de las caras articulares del hueso y del cartílago; irregularidad del espacio articular que acaso revele leve estrechamiento, dilatación y ahonde de la fosa intercondilar; y formación incipiente de quistes subcondrales e intraóseos. El período avanzado revela notable disminución y hasta ausencia del espacio articular, acentuada formación de quistes subcondrales e intraóseos, subluxación y anquilosis. Las articulaciones revelan además casi siempre formación de espolones marginales y esclerosis de los bordes yustaarticulares.

En los casos de los AA., la articulación de la rodilla fué la afectada más a menudo, viniendo después el codo y el tobillo. Varios enfermos mostraban cierre prematuro de las epífisis próximas a las articulaciones del codo y de la rodilla.

Congenital Absence of the Odontoid Process

Report of a Case[1]

TOM M. FULLENLOVE, M.D.[2]

CONGENITAL ABSENCE of the odontoid process has been reported in the literature only seven times since 1933. One of these reports was of 2 cases, so that a total of 8 cases have been recorded (1–3, 5–8). A ninth case is described in this paper.

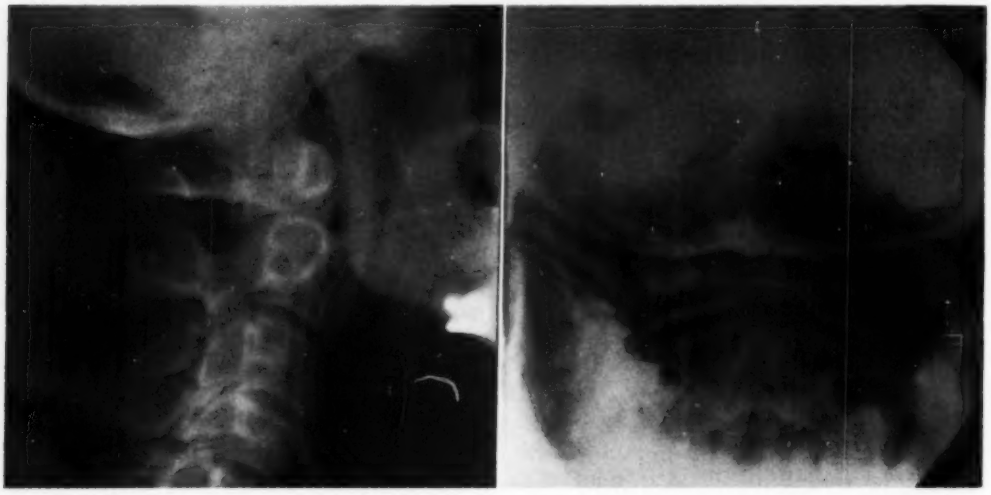


Fig. 1. Congenital absence of the odontoid. The absence is readily seen in the anteroposterior view. In the lateral projection, the characteristic appearance of flattening of the upper margin of C-2 is seen together with slight subluxation.

The odontoid process is ossified from three centers—two lateral centers, which soon merge, appearing in the fifth month, and one apical center, appearing from the second to fifth year. In the third or fourth year the odontoid process and the body of the axis co-ossify, the line of union being indicated frequently by a small disk of cartilage entirely surrounded by bone, which may persist to old age. The apical ossification center of the odontoid unites with the odontoid process proper at the twelfth year (4).

Failure of development of the three centers is undoubtedly what occurs to produce congenital absence of the odontoid process.

CASE REPORT

B. H., a 56-year-old male, complained of pain in the left trapezius muscle following head injury six weeks before hospital admission. He had been in good health up to that time, when he hit the top of his head on the rung of a ladder which he was climbing. He did not lose consciousness, but there was immediate onset of posterior cervical pain, which persisted. The past history revealed no unusual symptoms, pain, or previous injury to neck.

On physical examination, the neck was supple, and no masses were palpable in the cervical region. There was good range of motion of the head and neck. Some tenderness was noted over the posterior cervical musculature on the left. The remainder of the physical examination was negative. Roentgenograms (Fig. 1) revealed absence of the odontoid process, with characteristic flattening of the upper margin of C-2.

The patient received six diathermy treatments

[1] From the Department of Radiology, Franklin Hospital, San Francisco, Calif. Accepted for publication in July 1953.

[2] Assistant Clinical Professor in Radiology, University of California Medical School, San Francisco, Calif.

during his stay in the hospital and was much improved on discharge.

Franklin Hospital
14th and Noe Sts.
San Francisco 14, Calif.

REFERENCES

1. IVIE, J. MC.K.: Congenital Absence of the Odontoid Process. Report of a Case. Radiology **46:** 268–269, March 1946.

2. MIYAKAWA, G.: Congenital Absence of the Odontoid Process. A Case Report. J. Bone & Joint Surg. **34-A:** 676–677, July 1952.

3. NIEVERGELT, K.: Luxatio atlanto-epistrophica bei Aplaisie des Dens epistrophie. Schweiz. med. Wchnschr. **78:** 653–657, July 10, 1948.

4. PANCOAST, H. K., PENDERGRASS, E. P., AND SCHAEFFER, J. P.: The Head and Neck in Roentgen Diagnosis. Springfield, Ill., Charles C Thomas, 1940, pp. 807–808.

5. ROBERTS, S. M.: Congenital Absence of the Odontoid Process Resulting in Dislocation of the Atlas on the Axis. J. Bone & Joint Surg. **15:** 988–989, October 1933.

6. SCANNELL, R. C.: Congenital Absence of the Odontoid Process. A Case Report. J. Bone & Joint Surg. **27:** 714–715, October 1945.

7. STIEFEL, D. M.: Congenital Absence of the Odontoid Process. Report of a Case. J. Bone & Joint Surg. **32-A:** 946–947, October 1950.

8. WEILER, H. G.: Congenital Absence of Odontoid Process of the Axis with Atlanto-Axial Dislocation. J. Bone & Joint Surg. **24:** 161–165, January 1942.

SUMARIO

Falta Congénita de la Apófisis Odontoides. Presentación de un Caso

Preséntase un caso de falta congénita de la apófisis odontoides. Este parece ser el noveno caso que conste en la literature desde 1933. El enfermo era un sujeto de 56 años ingresado en el hospital con dolor persistente a continuación de un golpe recibido encima de la cabeza seis semanas antes.

Las radiografías revelaron la ausencia de la apófisis odontoides.

Roentgen Observations of the Ileostomy in Patients with Idiopathic Ulcerative Colitis

I. The Well Functioning Ileostomy[1]

FELIX G. FLEISCHNER, M.D., PAUL MANDELSTAM, M.D., and BENJAMIN M. BANKS, M.D.

DURING THE PAST twenty years, ileostomy has been employed with increasing frequency, either alone or with subtotal or total colectomy, for the treatment of patients with severe idiopathic ulcerative colitis. It has become apparent that immediate and late postoperative ileal dysfunction of varying severity is a relatively common complication of this procedure.

Warren and McKittrick (1), in a recent analysis of 210 cases in which ileostomy was done, found that two out of three patients (61.9 per cent) manifested evidence of ileal dysfunction at one time or another. The clinical aspects of this state, which were described in detail by these writers and need not be reviewed here, often constitute serious threats to life and, not uncommonly, result in death.

Profuse ileostomy drainage, *i.e.*, in excess of 1,000 c.c. per twenty-four hours, constitutes, according to Warren and McKittrick, presumptive evidence of ileal dysfunction, and the recording of the daily drainage is considered the single most important safeguard against missing this diagnosis.

Varying opinions concerning the normal function and morphology of the ileostomy and the prestomal ileum have found expression in the surgical literature. Cattell (2), for example, maintains that the ileal discharge is less watery and more inspissated after colectomy than after ileostomy alone, since in the former "the fluid absorptive property of the right colon is taken over by the terminal ileum and semisolid or formed soft discharges result." Ogilvie (3) has reached a different conclusion. He writes: "The patients in whom I have done ileostomy, and nothing else, have settled down, after varying periods, to passing semisolid ileal 'stools.'"

A search of the literature, both surgical and roentgenologic, has offered little elucidation as to the function of the small intestine and the morphology of the prestomal ileum in patients with well functioning ileostomies. The prevailing view appears to be that in every case of ileostomy there is considerable dilatation of the prestomal segment and that following colectomy this increases (2); it is to this post-colectomy dilatation that the semi-solidification of the ileal discharge is ascribed. No satisfactory data in support of these opinions, however, are available.

We have found roentgen examination of the prestomal ileum practical and informative, both for the evaluation of the individual case and for the understanding of ileostomy dysfunction in general. This present communication deals with the findings in patients with a well functioning ileostomy. Our observations on ileostomy dysfunction will be presented in a subsequent report.

CASE MATERIAL

Criteria for Selection: Thirteen patients (see Table I) who had been subjected to ileostomy for severe idiopathic ulcerative colitis were selected for this study. This group includes 4 men and 9 women, ranging in age from eighteen to thirty-seven years, all considered to be in good health and to have well functioning ileostomies. The criteria for selection were as follows:

(1) The body weight had been restored to the pre-illness level or, in case of pre-illness obesity, maintained at a level average for the patient's sex, age, and height.

[1] From the Department of Radiology and Department of Medicine, Beth Israel Hospital and Harvard Medical School, Boston, Mass. Accepted for publication in August 1953.

TABLE I: CLINICAL DATA OF 13 PATIENTS WITH WELL FUNCTIONING ILEOSTOMY

Case, Age, and Sex	Onset of Symptoms of Colitis	Date of Ileostomy	Date of Colectomy	Date of Perineal Resection of Rectum	Remaining Portion of Colon	Date of Last Ileal Dysfunction
1. J. G. 32 M	1950	Aug. 1950	Aug. 1950	Jan. 1951	None	July 1951
2. G. M. 32 M	1936	Dec. 1936	Ileocolostomy 1937 Colectomy Dec. 1950	...	Distal sigmoid and rectum	Dec. 1950
3. S. R. 34 M	1943	Mar. 1947	Aug. 1947	Feb. 1948	None	Jan. 1951
4. S. M. 27 M	1949	Mar. 1951	...	...	All	Apr. 1951
5. C. L. 34 F	1945	Nov. 1949	Nov. 1949	...	Distal to mid transverse colon	Dec. 1949
6. L. S. 30 F	(Infantile diarrhea; then asymptomatic) 1940	Mar. 1952	Apr. 1944	Apr. 1944	None	Sept. 1946
7. H. S. 37 F	1940	Jan. 1943	Oct. 1943	Mar. 1951	None	Mar. 1951
8. M. F. 18 F	1945	Mar. 1951	Mar. 1951	...	Distal sigmoid and rectum	Nov. 1952
9. T. K. 18 F	1951	Apr. 1952	...	...	All	June 1952
10. M. A. 29 F	1949	Nov. 1951	Nov. 1951	Oct. 1952	None	Oct. 1952
11. E. L. 29 F	1941	Mar. 1952	Mar. 1952	Mar. 1952	None	Mar. 1952
12. E. K. 24 F	1946	Feb. 1952	Oct. 1952	Oct. 1952	None	Oct. 1952
13. L. G. 36 F	1941	June 1951	Oct. 1952	Oct. 1952	None	July 1951

(2) There was freedom from colicky abdominal pain and from other evidence of partial obstruction.

(3) The volume and consistency of the ileal discharge were normal.

(4) The ileal discharge had no excessively foul odor (one of the earliest signs of ileostomy dysfunction).

(5) There was no ulceration of the abdominal wall surrounding the ileostomy.

Mild to moderate ileal prolapse through the stoma, when asymptomatic, was considered compatible with the definition of a well functioning ileostomy for the purpose of this study. Two patients in good general health and with well functioning small intestines, had stomal prolapses of 7.5 to 9.0 cm. in length.

The time elapsed since the ileostomy was instituted varied from thirteen months to eleven years. The time from the last episode of ileostomy dysfunction warranting medical attention, either conservative or surgical, varied from six months to seven years. No patient with evidence of ileostomy dysfunction within the preceding six months was included in this series.

Operative Status and Pathologic Residues: Ileostomy alone had been done in 2 patients, the entire colon being retained. In 3 cases *ileostomy and partial colectomy* were done: in 2 subtotal colectomy down to the rectosigmoid junction and in the third right hemicolectomy as far as the midtransverse colon. Eight patients were treated by *ileostomy and total colectomy*, including perineal resection of the rectum.

Two patients (Cases 9 and 10) had, in addition to severe colitis, involvement of the terminal ileum, as shown radiologically and at operation. Both have at present roentgen evidence of localized disease of the prestomal ileum. Because of their good general health and complete absence of ileostomy dysfunction, however, they have been included in this series.

General Rehabilitation and Adjustment: Of the 13 patients studied, 11 are leading

TABLE II: ROENTGENOLOGIC FINDINGS IN 13 SUBJECTS WITH WELL FUNCTIONING ILEOSTOMY

Case	Width of Prestomal Ileum*	Ileostomy Enema			Oral Transit in Hours	
		Kerkring's Folds		Formed Feces	Arrival of Barium at the Ileostomy	Clearing of the Ileum
		Type	Extension to the Stoma			
1. J. G.	Slightly widened	Widened	Complete	..	4	...
2. G. M.	Slightly widened	Narrow	Complete	..	1½	2½
3. S. R.	Slightly widened	Narrow	Complete	..	4	7
4. S. M.	Narrow	Narrow	Complete	+	5	7
5. C. L.	Narrow	Narrow	Complete	..	5	...
6. L. S.	Slightly widened	Slightly flattened	Complete	..	2½	...
7. H. S.	Slightly widened	Narrow	Complete	..	2½	...
8. M. F.	Narrow	Narrow	Complete	..	2	3
9. T. K.	Widened	Absent	Irregular relief for 30 cm.	..	4	5½
10. M. A.	Narrow	Absent	Irregular relief for 25 cm.	..	4	...
11. E. L.	Narrow	Narrow	Complete	+	2	3½
12. E. K.	Narrow	Slightly flattened	Almost complete	..	3	...
13. L. G.	Narrow	Narrow	Complete	+	...	...

* For the sake of analysis the following terms are used: narrow, 2.0 to 2.5 cm. diameter; slightly widened, 2.5 to 3.2 cm.; widened, 3.2 to 4.0 cm.

normal lives, with full-time activity, in pursuits consistent with their age and sex. Two are students, 3 are housewives, 4 earn their living in gainful employment or in independent business, and 2 women hold full-time positions and keep house as well. One patient, although in good health for over two years, has not sought steady employment since ileostomy, but has been pursuing a program of vocational rehabilitation under Veterans' Administration auspices. One patient, with a history of psychosis at the time of emergency surgery, is now able to work three hours daily with comfort, but becomes weak, tired, and depressed if her working hours are increased above this limit. Four patients, 3 women and 1 man, have married subsequent to ileostomy.

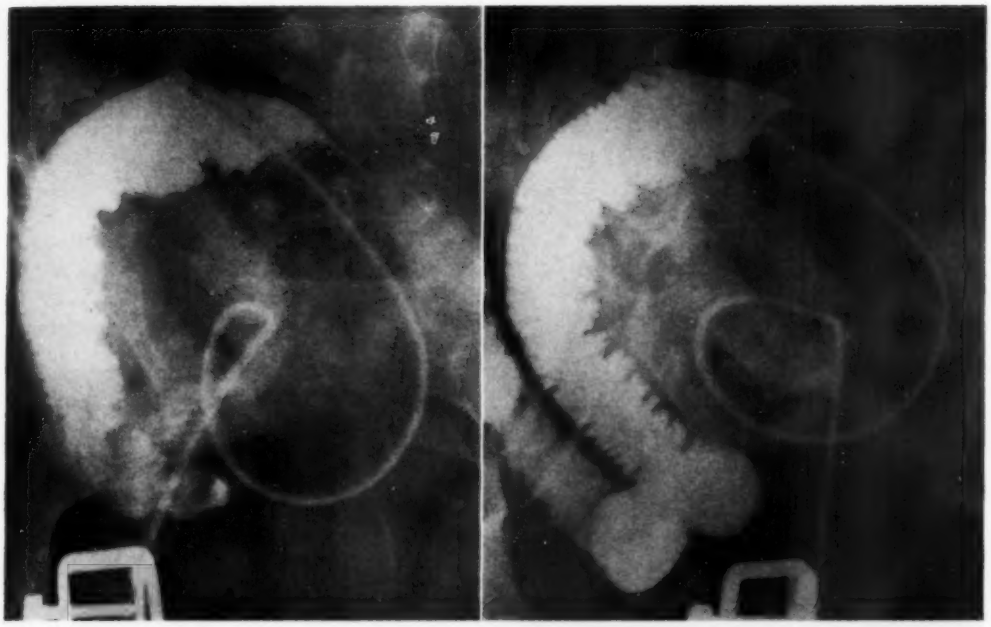
METHOD

The small intestine was studied both by barium enema through the ileostomy stoma and by oral passage of barium.

With the patient supine on the fluoroscopic table, the ileostomy bag and ring were removed. A Foley catheter, Bardex No. 18, was passed into the stoma for 10 to 15 cm. In two instances, in which this thin catheter could not easily be passed beyond the cutaneous ring, a thicker and more rigid catheter, No. 30, was successfully used. The balloon was inflated with 15 c.c. of air, without substantial discomfort to any patient. The catheter appeared to be well anchored in every case. Under fluoroscopic control, the barium-water suspension[2] was slowly injected, and spot films were taken as the filling proceeded. With palpation and rotation of the patient, the individual ileal loops were isolated and inspected. Survey films were then taken. Thirty minutes later, after a variable amount of the injected barium had been evacuated, another roentgenogram was obtained.

The examination by oral passage was performed with the usual barium-water suspension used for the examination of the upper gastrointestinal tract. The first roentgenogram was taken two hours after the suspension had been administered, and further films were taken at hourly intervals, until the barium had reached the ileostomy and had, in varying measure, been evacuated.

[2] One part barium sulfate to 3 parts water by volume, plus tannic acid to make a 0.3 per cent solution, as used in this clinic for routine examination of the colon.



ROENTGEN OBSERVATIONS
(*Table* 2)

Morphology of the Prestomal ileum: In 6 of the 11 patients without present radiologic evidence of ileal disease, the prestomal ileum was found to be narrow, 2.0 to 2.5 cm.; in the remaining 5 it was slightly wider, 2.5 to 3.2 cm. In both groups, however, it was within normal limits.

A barium enema study showed the presence of Kerkring's folds, extending down, or almost down, to the stoma (Fig. 1) except in the 2 patients with ulcerative disease of the prestomal ileum, in whom the folds were absent for a distance of 25 to 30 cm. and the mucosal relief of this segment was grossly irregular. During oral passage of barium, the circular folds were in general less frequently seen and, if present, were less prominent. This observation parallels the findings in normal subjects, in whom, on filling from the cecum, the folds in the terminal ileum are present with much greater regularity and prominence than on oral passage.

In 3 patients, small pieces of solid fecal material could be seen in the prestomal ileum (Fig. 2). One of these patients had

Fig. 1. Case 5: C. L. female, 34 years. Right colectomy and ileostomy 1949. Barium enema through ileostomy using a Foley catheter. The inflated balloon is seen in front of the 5th lumbar vertebra. The fingers of the patient's hand holding the catheter are visible. The prestomal ileum is normal in width and the circular mucosal folds are visible down to the balloon. A, B, and C of a series of six spot films taken during the inflow of barium.

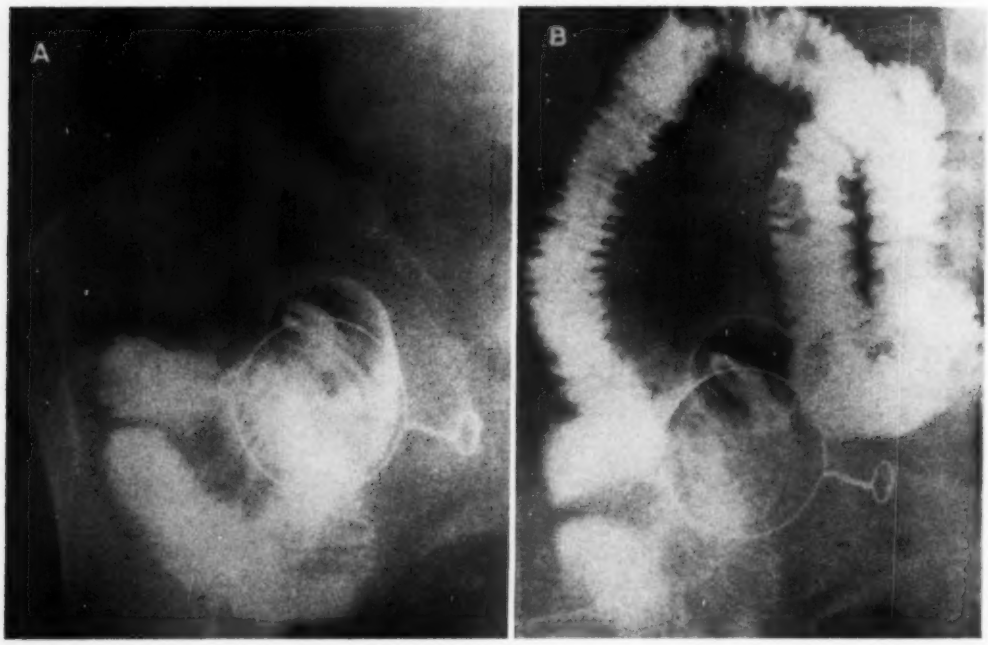


Fig. 2. Case 4: S. M. male, 27 years. Ileostomy in March 1951; no resection of any part of the bowel. The wire ring is part of the ring of the ileostomy bag. The catheter is seen entering the picture at the bottom on the left. The air-filled balloon is in the center of the pictures. The irregular filling defects in B are caused by pieces of solid feces.

undergone ileostomy alone, the colon being completely preserved.

In none of the 13 patients with well functioning ileostomies was there any gush or, indeed, any discharge at all of liquid intestinal contents through the catheter introduced for the barium enema study. In contrast, patients with dysfunction of the ileostomy commonly expel considerable amounts of ileal content when the catheter is inserted.

Small Intestinal Motility: The transit time of the orally administered barium varied considerably among the 13 subjects. In those with most rapid passage, the barium reached the stoma in one and a half to two and a half hours, and most of it had been evacuated by three and a half hours, whereas, in the most sluggish, four to five hours were required for the appearance of the barium at the stoma, and up to seven hours for its evacuation. In 2 of the latter cases, delayed gastric evacuation, apparently related to moderate gastroptosis, was a contributory factor. This range in transit time is entirely in keeping with that observed in healthy subjects.

DISCUSSION

Very little is known about the normal morphology and function of the prestomal ileum. Called upon to evaluate instances of ileostomy dysfunction roentgenologically, we found ourselves operating almost in a vacuum. We therefore undertook this study of well functioning ileostomy cases in order to acquaint ourselves with the "normal ileostomy."

The mucosal relief and the motor function of the small intestine are demonstrable on roentgen examination. The heaping up of the mucosa into Kerkring's folds starting beyond the duodenal bulb appears to be the inherent property of the entire small intestine. In contradiction of former teachings (4), these plicae conniventes can be seen in the mid and lower ileum during certain phases of digestion in

perfectly healthy subjects, and with great frequency in the pathologically irritated ileum during oral passage of barium. Moreover, if the terminal ileum is visualized by overflowing barium from the cecum in the course of a barium enema, the transverse folds in the terminal ileum are observed quite frequently, this non-physiologic filling apparently providing a sufficient stimulus for their appearance under otherwise normal conditions. On the other hand, the presence of circular folds in the lower ileum during oral passage of barium may occasionally suggest pathologic irritation of the ileum (5). Generally the activity and pattern of the mucosa, Forssell's "autoplasty" (6, 7), are controlled mainly by the activity of the muscularis mucosae and the turgor of the submucous tissue. The folds may disappear with distention or inflammation of the bowel.

The study of the small intestine by oral passage of barium failed to reveal any abnormality in patients with well functioning ileostomies. The transit time was found entirely within the limits observed in normal individuals, if one substitutes the arrival of the barium at the ileostomy opening for arrival at the cecum. The pattern in the jejunal loops, the width and contours of the ileal loops, and the distribution of barium were normal.

The enema studies have been most revealing. In all normal subjects the prestomal ileum was found to be narrow, 2.0 to 2.5 cm. in diameter, or slightly wider, 2.5 to 3.2 cm., but within normal limits. Circular folds were present down close to the stoma; in a few instances (Cases 1 and 6) they were slightly flattened. We consider this normal rugal pattern, under the conditions of this type of examination, an essential feature of a healthy ileum.

The finding of formed fecal matter, measuring up to 1 × 3 cm., in the prestomal ileal segments in 3 patients, in 2 of whom the colon had been completely removed, supports Ogilvie's contention that the lower ileum is capable of inspissating its content, whether or not the colon has been removed.

In none of these patients did any intestinal content escape when the catheter was inserted for the barium enema. Counsell and Goligher (8) found, in instances of ileostomy dysfunction, that the insertion of a catheter through the ileostomy opening was followed by the escape under pressure of some 200 to 300 c.c. of ileal content. Warren and McKittrick consider the discharge of large amounts of intestinal content through such a catheter proof of serious ileostomy dysfunction. These clinical observations of copious discharge, suggesting dilatation of the prestomal ileum and formation of a reservoir, in cases of dysfunction, and the absence of such discharge with well functioning ileostomies are in good accord with the morphological findings of this study. *In the well-functioning ileostomy the prestomal ileum is of normal width.*

In 2 instances (Cases 9 and 10), changes in the prestomal loop were found which appear to indicate chronic ileitis, probably ulcerative. For a distance of 25 to 30 cm. the contour of the loop was irregular and frayed out; the relief was grossly irregular; the lumen was narrow in one instance, widened in the other. The ileum proximal to this diseased segment was about normal in width, contour, and rugal pattern. In both these cases disease of the terminal ileum was known to have existed prior to operation. They were included in this analysis because there had been no interference with good ileostomy function and good general health.

SUMMARY

The roentgen findings in 13 patients with a well functioning ileostomy for six months or longer have been described. The ileostomy had been performed for severe idiopathic ulcerative colitis and had been accompanied or followed by partial or total colectomy in 11 instances.

The examinations were performed by oral passage of barium and barium enema through the ileostomy opening.

In instances of well functioning ileostomies without disease of the ileum it was

found that the transit time for barium administered orally and the motility pattern of the small intestine were normal. The lower ileum was found capable of inspissating its content, as evidenced by the presence of formed fecal matter even though the colon had been removed.

The prestomal ileum, visualized by barium enema through the ileostomy, was normal in width and contour and showed a normal circular rugal pattern. There was no evidence of dilatation or reservoir function of the prestomal ileum.

ADDENDUM

C. Dennis and Karl E. Karlson in a recent report (Surgical Measures as Supplements to the Management of Idiopathic Ulcerative Colitis. Surgery **32**: 892–912, November 1952) stated that, in cases where no diseased ileum was retained and the ileostomy was correctly performed, there was no evidence, roentgenologically or on exploration, of enlargement of the proximal ileum.

REFERENCES

1. WARREN, R., AND MCKITTRICK, L. S.: Ileostomy for Ulcerative Colitis; Technique, Complications, and Management. Surg., Gynec. & Obst. **93**: 555–567, November 1951.

2. CATTELL, R. B.: The Care of Ileostomy. Lahey Clin. Bull. **4**: 45–52, October 1944.

3. OGILVIE, W.H.: Surgical Treatment of Idiopathic Ulcerative Colitis and Its Sequelae. Proc. Roy. Soc. Med. **33** (Part 2): 637–648, May 1940.

4. Gray's Anatomy of the Human Body. 25th ed., edited by C. M. Gross. Philadelphia, Lea & Febiger, 1948, pp. 1216–1219. Also MAXIMOW, A. A., AND BLOOM, W.: A Textbook of Histology. Philadelphia, W. B. Saunders Co., 5th ed., 1948.

5. FLEISCHNER, F. G., AND BERNSTEIN, C.: Roentgen-Anatomical Studies of the Normal Ileocecal Valve. Radiology **54**: 43–58, January 1950.

6. FORSSELL, G.: Mechanism of Movement of the Mucous Membrane of the Digestive Tract. Am. J. Roentgenol. **10**: 87–104, February 1923.

7. FORSSELL, G.: Beobachtungen über die Autoplastik des Digestionskanales. Fortschr. a. d. Geb. d. Röntgenstrahlen **37**: 393–394, March 1928.

8. COUNSELL, P. B., and GOLIGHER, J. C.: Surgical Treatment of Ulcerative Colitis. Lancet **2**: 1045–1050, Nov. 29, 1952.

330 Brookline Ave.
Boston 15, Mass.

SUMARIO

Observaciones Roentgenológicas de la Ileostomía en Enfermos con Colitis Ulcerativa Idiopática

A modo de perspectiva para estudiar la disfunción ileal que sigue frecuentemente a la ileostomía ya con o sin colectomía total o subtotal por colitis ulcerada, se verificó un estudio de la ileostomía que funciona bien. El estudio comprendió a 13 enfermos: 2 en quienes no se había efecutado más que la ileostomía, 3 con ileostomía y colectomía parcial y 8 con ileostomía y colectomía total incluso resección perineal del recto. Para los exámenes, se administró bario por vía bucal y en forma de enema por la abertura colostómica.

Excluídos 2 enfermos con afección residual de la porción preestomal del íleon, observóse que, cuando la ileostomía funcionaba bien, el tiempo requerido para el paso del bario administrado oralmente y el patrón de movilidad del intestino delgado eran normales. La porción inferior del íleon demostró su capacidad para espesar el contenido del mismo, según evidenció la presencia de trozos de heces formadas.

La porción preestomal del íleon, visualizada por el enema de bario a través de la ileostomía, era normal en su ancho y contorno y reveló un patrón de arrugas circulares normales. No había signos de dilatación de dicha porción ni de formación de un depósito, como se observa cuando hay disfunción de la ileostomía.

Interstitial Gastric Emphysema, with Report of a Case[1]

J. JAMES CANCELMO, Jr., M.D.

GASTRIC EMPHYSEMA is a rare condition characterized by air within the wall of the stomach and a few vague symptoms or none at all. We have been able to find but 4 cases of gastric emphysema in the literature (1, 2, 5). All of these occurred following gastroscopy, and in each case the gas disappeared spontaneously.

The present case of gastric emphysema developed in a patient with carcinoma of the esophagus, following a bout of vomiting and attempted intubation of the stomach. Our purpose in reporting it is to differentiate gastric emphysema from emphysematous gastritis and cystic pneumatosis gastrica.

Fig. 1. Supine view. The stomach is filled with gas. Note the thin linear radiolucent shadow along the greater curvature. This was interpreted as representing gas within the stomach wall. The tube is lying on the anterior abdominal wall and its tip is in the jejunostomy stoma.

CASE REPORT

A 71-year-old white female was admitted to the hospital on March 3, 1952, with dysphagia of three months duration and a 17-pound weight loss. The systemic review and family and past histories were non-contributory except that primary pernicious anemia had been diagnosed in 1945 and treated with liver extract and vitamin B_{12}. Positive physical findings consisted of slight pharyngeal injection and minimal cardiac enlargement. No masses were palpable in the epigastrium. Laboratory examination on the day of admission showed a hemoglobin of 11.8 gm., red cells 4,800,000, and white cells 10,800, with a normal differential count.

A roentgenogram of the chest made on admission revealed a diffuse mottling of the right lower lobe. A barium study disclosed an 8-cm. filling defect in the lower third of the esophagus, causing almost complete obstruction with moderate dilatation proximally. The stomach and duodenum appeared free of disease. The radiologic diagnosis was carcinoma of the esophagus with right lower lobe bronchopneumonia secondary to aspiration.

The patient was presented at a tumor conference, where esophagoscopy was recommended to confirm the diagnosis. Esophagoscopic examination, March 11 and 18, revealed an extensive, infiltrating, ulcerating lesion of the lower third of the esophagus encroaching on the lumen. A biopsy specimen obtained at the second examination was reported as showing squamous-cell carcinoma.

A thoracotomy was planned for March 24 but was abandoned because of the development of severe hypotension immediately after the patient was anesthetized. A simple feeding jejunostomy was performed instead. The stomach and lower end of the esophagus were not explored at this time.

On the second postoperative day severe vomiting began, continuing for five days, during which time all feeding through the jejunostomy tube was discontinued. An unsuccessful attempt was made to pass a Levin tube by mouth on the seventh postoperative day. The patient's temperature, previously normal except for a slight rise immediately after operation, spiked to 101°, and the white cell count rose to 11,300. On the eighth postoperative day the vomiting stopped, the temperature became normal, and jejunostomy feeding was resumed. X-ray examination on the ninth day revealed no obstruction at the site of the jejunostomy but showed a large ring-shaped radiolucency in the left upper quadrant, which appeared to outline the stomach (Fig. 1). Films exposed in the semierect and right lateral decubitus positions showed the areas of radiolucency to be separate from the gastric air bubble (Fig. 2). These films were interpreted as representing air within the wall of the stomach. Administration of Iodochloral by mouth failed to show an esophageal perforation. There was no evidence of mediastinal emphysema. During the course of the examination the patient complained of vague left upper quadrant distress.

With subsidence of vomiting, improvement was rapid. Roentgen examination on the eighteenth postoperative day failed to show any air within the

[1] From the Presbyterian Hospital, Philadelphia, Penna. Accepted for publication in July 1953.

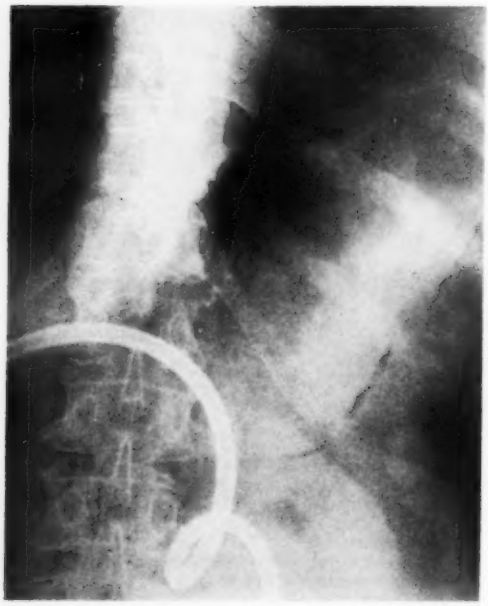


Fig. 2. Semi-erect view. Note the gas extending along the greater curvature of the stomach and up over the fundus. This linear radiolucency is separate from the gas within the lumen of the stomach.

stomach wall, and on the twentieth day the patient was discharged to be followed in the clinic.

DISCUSSION

The interstitial emphysema observed in this case was probably due to a combination of several unique factors. The wall of the esophagus was already weakened if not actually perforated by a carcinoma. In addition, the trauma secondary to attempted passing of a Levin tube through an almost completely obstructed esophagus was, in itself, enough to cause mucosal perforation. The postoperative vomiting, which increased the intraluminal pressure, was sufficient to force air through the perforation into the esophageal wall. Since the circular and longitudinal musculature of esophagus and stomach are continuous, it is certainly possible for the air to have dissected its way down into the wall of the stomach.

We are assuming that this perforation was incomplete or in some way walled off. Otherwise we would have found mediastinal emphysema. One would also expect to see air in the wall of the distal esophagus, but this could not be demonstrated. If our interpretation is correct, bacteria should have passed with the air into the involved walls. The fever and leukocytosis would seem to indicate some infection. However, the prompt fall in the temperature and white blood count without the aid of antibiotics seems to rule out this possibility. This absence of infection, at least in the surgical sense, and dissociation of the roentgen findings and the symptoms have been noted previously (2).

We considered the possibility of the introduction of air at the time of esophagoscopy, but fifteen days had elapsed between the esophagoscopic examination and the discovery of the gastric emphysema. In one case of gastric emphysema (following gastroscopy) the authors (5) reported disappearance of the air in seventy-two hours.

It is certain that air was not introduced at the time of operation, since only the jejunum was delivered through the incision and no attempt was made to explore the esophagus and stomach.

DIFFERENTIAL DIAGNOSIS

When air is seen in the stomach wall, three conditions must be considered: interstitial emphysema, cystic pneumatosis, and emphysematous gastritis. The first two are essentially asymptomatic, benign, and characterized by spontaneous disappearance of the air. Emphysematous gastritis, on the other hand, is an acute cellulitis associated with very severe symptoms and carries a high mortality.

Myhre and Wilson (5) found interstitial gastric emphysema in 2 of 119 patients who were studied twenty-four hours following gastroscopy. Both patients were entirely asymptomatic except for slight tachycardia. The air appeared as a thin line of decreased density in the left upper quadrant of the abdomen, outlining the stomach but separate from the gastric air bubble. The picture is identical with that seen in our case, the only difference being in etiology, although the circumstances are somewhat similar.

Pneumatosis cystoides intestinalis is a condition of minor pathological importance. The small bowel is most commonly the site of involvement. There have been about 175 cases reported in the literature (4). The condition is usually discovered incidentally at laparotomy. Radiologically it is characterized by multiple air-filled cysts. When it involves the stomach, which is unusual, the cysts are usually confined to one wall and appear there in grape-like clusters. This is in contrast to the more diffuse involvement seen in emphysematous gastritis. Absence of symptoms and spontaneous disappearance of the air cysts are constant and conclusive findings.

Henry (3) has recently reported the fifth case of emphysematous gastritis on record. Only one patient has survived. This condition is a phlegmonous gastritis caused by gas-forming organisms. Trauma or previous gastric disease was observed in all of the reported cases. The disease is marked by the sudden onset of epigastric pain, nausea, and hematemesis, associated with a marked temperature rise, rapid pulse, leukocytosis, and often prostration and shock. The roentgen findings are striking (3, 6), consisting of innumerable small gas bubbles of various shapes within the gastric wall. These bubbles, superimposed on one another at the margins of the stomach, produce mottled bands of decreased density outlining the gastric wall, especially along the curvatures. Such changes are in definite contrast to the thin, rather smooth line of radiolucency outlining the stomach wall in simple gastric emphysema. If confusion should arise in differentiating gastric emphysema from emphysematous gastritis roentgenologically, they can be easily differentiated clinically. Simple gastric emphysema is relatively asymptomatic, while emphysematous gastritis is associated with severe symptoms and a rapid, often fatal course.

SUMMARY

A case of interstitial emphysema believed to be secondary to esophageal perforation is reported. This condition is to be distinguished from cystic pneumatosis and from emphysematous gastritis. The characteristic roentgen finding is a rather smooth line of radiolucency outlining the stomach wall.

NOTE: The author wishes to express his appreciation for the privilege of reporting this case from the service of Orville C. King, M.D., and Ernest G. Williamson, M.D.

Coatesville Hospital,
Coatesville, Penna.

REFERENCES

1. CHAMBERLIN, D. T.: Pneumoperitoneum Following Gastroscopy Apparently without Perforation. Report of a Case. New England J. Med. **237**: 843–845, Dec. 4, 1947.
2. FIERST, S. M., ROBINSON, H. M., AND LASAGNA, L.: Interstitial Gastric Emphysema Following Gastroscopy; Its Relation to the Syndrome of Pneumoperitoneum and Generalized Emphysema with No Evident Perforation. Ann. Int. Med. **34**: 1202–1212, May 1951.
3. HENRY, G. W.: Emphysematous Gastritis. Am. J. Roentgenol. **68**: 15–18, July 1952.
4. JACKSON, J. A.: Gas Cysts of the Intestine. Surg., Gynec. & Obst. **71**: 675–678, November 1940.
5. MYHRE, J., AND WILSON, J. A.: A Study on the Occurrence of Pneumoperitoneum After Gastroscopy and the Observance of Interstitial Emphysema of the Stomach. Gastroenterology **11**: 115–119, July 1948.
6. WEENS, H. S.: Emphysematous Gastritis. Am. J. Roentgenol. **55**: 588–593, May 1946.

SUMARIO

Enfisema Gástrico Intersticial

Preséntase un caso de enfisema gástrico en una anciana de setenta años que padecía de carcinoma escamocelular de la porción inferior del esófago. Parece que el enfisema se debía a debilitamiento o perforación de la pared esofágica por el carcinoma y a aumento de la presión intraluminal ocasionado por los vómitos consecutivos a la yeyunostomía. El aire forzado así a la pared del esófago tal vez se abriera entonces paso hacia abajo a la pared gástrica.

El enfisema gástrico intersticial tiene

que ser diferenciado de la neumatosis quística y de la gastritis enfisematosa. El cuadro roentgenológico, consistente en una línea delgada y algo lisa de radiolucencia que demarca la pared gástrica, pero que está separada de la burbuja gástrica, es típico del enfisema gástrico simple y debe servir para hacer la diferenciación. La neumatosis quistoidea caracterízase por la existencia de muchos quistes gaseosos, por lo general en forma de racimos acinosos, limitados a una pared, mientras que la gastritis enfisematosa muestra grandes cantidades de burbujas gaseosas en la pared gástrica, formando una franja moteada de menor densidad.

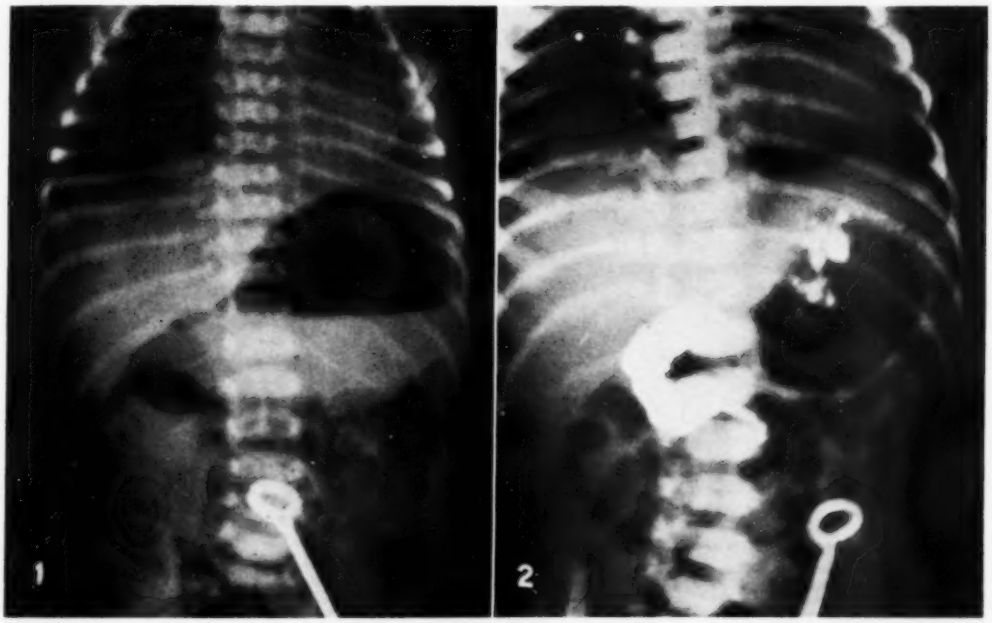
El enfisema gástrico simple es relativamente asintomático y benigno, desapareciendo espontáneamente, en tanto que la gastritis enfisematosa va acompañada de síntomas graves y prosigue una evolución rápida y casi siempre letal.

Congenital Obstruction of the Duodenum and Malrotation of the Colon[1]

SIMON DOLIN, M.D., HUGH H. MATHEWS, M.D., and PETER E. RUSSO, M.D.

With advances in surgery and the use of the antibiotics, the prognosis of congenital obstruction of the duodenum has become much more favorable. Better understanding of the embryology and pathogenesis has likewise contributed toward a more successful management. Nevertheless, the outcome of surgical correction depends largely on early recognition and on exact diagnosis of the type and degree of obstruction.

The purpose of this paper is to present 2 cases of extrinsic congenital obstruction of the duodenum, to discuss the diagnostic problems involved, and to emphasize the possibilities of early roentgen diagnosis of this condition.



Figs. 1 and 2. Case I. Fig. 1, a plain roentgenogram of the abdomen, shows the stomach and the dilated duodenum as well as the narrowing at the level of the distal end of the third portion of the duodenum.
Fig. 2. A Lipiodol swallow outlines the exact location of the duodenal obstruction.

Case I: T.L.P., a white female infant, was born at the University Hospital on Feb. 10, 1953, and immediately became a feeding problem. She regurgitated each feeding and soon vomited bile-stained material. The family history was not contributory. Physical examination and laboratory studies were not remarkable. A plain roentgenogram of the abdomen revealed a narrowing of the distal end of the third portion of the duodenum, the stomach and the duodenum being well outlined by air (Fig. 1). Gas-filled loops of bowel were seen mostly on the left side of the abdomen. Obstruction of the third portion of the duodenum was suspected. A Lipiodol swallow confirmed this impression and outlined the exact location of the duodenal obstruction (Fig. 2). Barium-enema examination revealed a malrotation of the colon, the cecum and ascending colon being situated to the left of the second vertebral segment, overlying the area of duodenal obstruction (Fig. 3).

[1] From the Department of Radiology, University and Crippled Children's Hospitals, University of Oklahoma, School of Medicine. Accepted for publication in July 1953.

Fig. 3. Case I. A barium enema reveals the malrotation of the colon, the cecum and ascending colon being located to the left of the mid-line.

Preoperative Diagnosis: Extrinsic obstruction of the duodenojejunal junction due to malrotation of the colon.

The patient was explored seventy-two hours after birth. At operation (Fig. 6) the stomach and duodenum were found in normal position. The transverse, descending, and sigmoid colon was in normal position. The right colon, however, doubled back on the root of the mesentery, and the cecum and appendix (Fig. 6, *B*) were adherent to the mesentery in the region of the ligament of Treitz by a broad adhesive band (Fig. 6, *C*) running over the duodenojejunal junction. The duodenum proximal to this level was distended (Fig. 6, *A*). The attachment of the root of the mesentery was short, and the greatest part of the small bowel was twisted on the base of the mesentery about 450° in a clockwise direction (Fig. 6, *D*). The volvulus was reduced, the adhesive band was freed, and the cecum was placed in the left lower quadrant. The immediate postoperative course was uneventful, and the baby was placed on normal feeding.

CASE II: T.K., a 13-year-old white boy, was in normal health until three weeks prior to admission

Figs. 4 and 5. Case II. Fig. 4. Plain roentgenogram of the abdomen (the patient had a barium meal examination elsewhere). The stomach is outlined by swallowed air. The proximal duodenum is distended. Barium outlines the narrowed distal part of the duodenum and duodenojejunal junction.

Fig. 5. Roentgenogram of the abdomen the following day shows a marked distention of the duodenum. Barium is still present in the narrowed segment. Most of the bowel pattern is to the left of the mid-line.

to the University Hospital, at which time severe abdominal pain developed, followed by vomiting. After admission on Feb. 19, 1953, the child continued to have abdominal pain of a cramping nature, relieved by vomiting bile-stained material. During the three weeks preceding his admission to the hospital, the patient had only two bowel movements, induced by enemata. His mother stated that, since two weeks of age, he had experienced attacks of vomiting and abdominal pain every three or four months. Since the age of five, these attacks had been more severe, often lasting several days, and the patient had been hospitalized on several occasions. No final diagnosis was given to the mother.

Physical examination revealed an extremely emaciated and dehydrated boy, with early decubitus on the trochanters and over the sacrum. There was no abdominal distention, and the remainder of the physical examination was not significant. A roentgenogram of the abdomen on admission revealed distention of the second part of the duodenum by swallowed air (Fig. 4) (the patient had had a barium meal examination prior to this admission). Barium outlined a narrowed segment at the level of the distal end of the duodenum and the duodenojejunal junction. No intestinal loops could be outlined in the right abdominal flank. Extrinsic obstruction of the third part of the duodenum and malrotation of the colon were suspected. The following day the abdomen became more distended and there were obstructive bowel sounds. A repeat roentgenogram revealed a marked increase in the degree of distention of the proximal two thirds of the duodenum; barium was still present in the previously noted narrowed segment (Fig. 5). The earlier impression of an obstruction of the third part of the duodenum and malrotation of the colon could thus be confirmed. The fluid and electrolyte imbalance was corrected and on Feb. 24, five days after admission, exploration was undertaken. At operation, the small bowel was found to be twisted on the base of the mesentery about 540° in a clockwise direction. The cecum and the right colon were situated in the left upper abdominal quadrant. A large adhesive band was present, running across the duodenojejunal junction. The volvulus was reduced, and the adhesive band was freed. The distended proximal portions of the duodenum immediately assumed a normal appearance. The postoperative course was uneventful, and three weeks later the patient was asymptomatic, having already gained 14 pounds in weight.

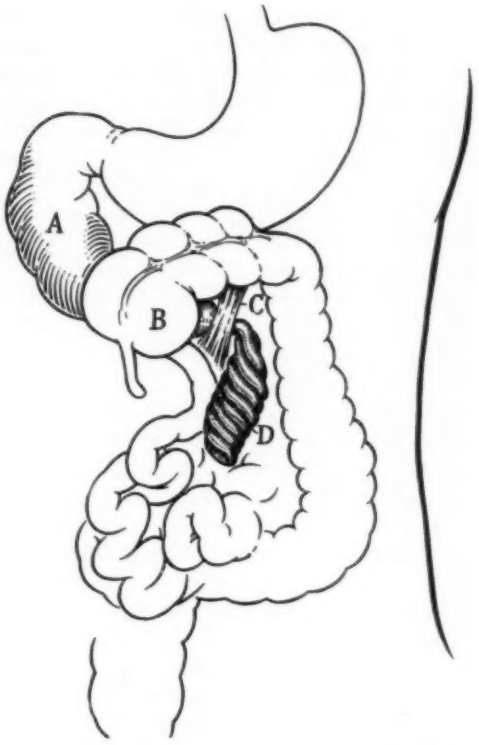


Fig. 6. Schematic drawing of operative findings: A. Distended proximal duodenum. B. Cecum. C. Adhesive band. D. Volvulus of the small intestine.

DISCUSSION

These two patients exhibited the same congenital abnormalities, faulty mesenteric attachment and malrotation of the colon, resulting in a volvulus of the midgut and an extrinsic obstruction of the distal part of the duodenum. Both cases have been surgically corrected after prompt recognition of the underlying anomaly, the first case early in life and the second case only after numerous recurrent attacks of duodenal obstruction. It is not our purpose to discuss at length the embryology of the gastrointestinal tract. Many excellent papers have been published on this subject (13, 14, 18). We shall limit ourselves to a few general remarks.

There is a disproportion in the growth rate of the peritoneal cavity and the intestinal tract. Consequently, the midgut and the dorsal mesentery undergo a rotation of 270° in the counterclockwise direction. The so-called post-arterial segment of the midgut (14)—terminal ileum, cecum, ascending colon, and right half of the trans-

verse colon—passes successively from the left side of the abdomen to the left upper quadrant, epigastrium, and right upper quadrant. After completion of the rotational process, the midgut loses its common mesentery. The small bowel and its mesentery become attached to the posterior abdominal wall by a peritoneal reflection. Similarly, the cecum and ascending colon become attached to the right side of the abdominal cavity. The duodenum loses its posterior mesentery and it likewise becomes attached to the posterior abdominal wall. Incomplete rotation may result in many complicating features. These depend on the stage in which the counterclockwise rotation of the midgut has been arrested.

The two cases reported here obviously represent an early arrest (eighth to tenth week of embryologic life) in the phase of rotational development (14, 18). In both cases the cecum was found in the left upper abdominal quadrant and the common mesentery of the midgut was still present. This mesentery was attached to the posterior abdominal wall by a short narrow rudimentary band of peritoneal reflection. The persistence of this rudimentary attachment predisposes the midgut to the mechanism of volvulus in a clockwise direction (18, 19). This phenomenon occurred in both cases: a volvulus of about 450° in a clockwise direction in the first case and of about 540° in the same direction in the second. In addition, both patients had persistent broad peritoneal bands constricting the duodenum at the duodenojejunal junction. These peritoneal sheets represent congenital reflections and, according to Caffey (4), their persistence is due to a failure in resorption. Such bands are found in nearly all cases of malrotation of the midgut (4) and add to the mechanism of duodenal obstruction.

A third factor contributing toward the obstruction of the duodenum is direct pressure by the abnormally situated, distended cecum (14).

The clinical picture depends on the degree of duodenal obstruction and on the volvulus itself. Swenson (20), Ladd (9), and Spencer (19) distinguish three clinical groups.

1. *Volvulus neonatorum*, represented by our first case (T.L.P.). These patients begin to vomit bile-stained material soon after birth. Examination may or may not reveal distention and fullness of the upper abdomen. When there is incomplete obstruction, stools are passed, and the Farber test shows the presence of epithelial cells (14). The following conditions have been considered in the differential diagnosis: congenital duodenal atresia (1, 5, 11), congenital hypertrophic stenosis of the pylorus (13), intussusception (8), fibrocystic disease of the pancreas (16), meconium ileus, and extrinsic obstruction of the duodenum by a tumor.

2. *Intermittent duodenal obstruction*, manifested by recurrent attacks of vomiting and cramping abdominal pain. The children are often undernourished and underdeveloped and present a diagnostic problem to the attending physician. Our second case (T.K.) is a representative example of this group. Spencer points out that the clinical picture often resembles the one seen in cases of non-specific mesenteric adenitis (19).

3. A small group in which the condition is *asymptomatic* and only accidentally discovered.

X-ray examination, either by plain roentgenograms or with a contrast medium, will in a great majority of the cases establish the diagnosis. Plain films of the abdomen reveal the presence of swallowed air in the stomach and in a dilated duodenum proximal to the site of obstruction. However, if a previous feeding has not been vomited, the stomach and duodenum will not be outlined. Mellins and Milman (12) advocate the passage of a Levine tube and aspiration of the gastric contents. Air is then injected through the tube and serial roentgenograms are taken. These authors, as well as Swenson and Ladd (20), emphasize the importance of the plain roentgenogram. Exact radiographic outline of the site of the obstruction can be ob-

tained after administration of a contrast medium by mouth. We agree with Swenson and Ladd, Spencer (19), Michel (14) and others, however, that barium administration by mouth in infants is a hazardous procedure, mainly because of the risk of aspiration. Lipiodol has proved to be a satisfactory contrast medium in these particular cases.

Further diagnostic details can be obtained by barium enema examination, and we feel that this should be undertaken in all cases of possible congenital obstruction of the duodenum.

Congenital duodenal obstruction from extrinsic pressure—congenital bands and malrotation of the colon—comprise 30 to 58 per cent of all forms of congenital intestinal obstructions in children (1, 9, 10, 19). Yet Cohen states that only 4 patients had been known to survive operative correction prior to 1927 (5). In 1922, the mortality rate was as high as 99.5 per cent according to Davis and Poynter (6). It has been considerably improved in the last two decades. Michel and Jarrell, in 1951, reported a mortality of 11.1 per cent for a large series of congenital intestinal obstructions in children, and state that "the mortality rate is still a great deal higher than it should be" (14).

Early and adequate surgical correction of the congenital anomaly is of prime importance. Ladd (9, 10) has pointed out that an infant during forty-eight hours of life presents a better surgical risk than it does a week or so later. According to this author, a delay in surgical intervention is justified only in order to correct fluid and electrolyte imbalance and to administer blood or plasma transfusions, as was done in Case II, above.

The favorable outcome of surgical correction undoubtedly depends on the prompt and exact recognition of the underlying anomaly. "There is perhaps no area of pediatric roentgenology where the patient benefits from early accurate diagnosis or where he suffers more from late or inaccurate diagnosis" (Caffey), than in congenital obstruction of the duodenum.

SUMMARY

1. Two cases of congenital extrinsic obstruction of the third part of the duodenum have been presented.
2. The embryology of these congenital anomalies has been reviewed.
3. Early diagnosis by plain roentgenograms of the abdomen and the use of a contrast medium as an additional diagnostic measure have been discussed.
4. The importance of early and exact diagnosis has been emphasized.

ADDENDUM

Since this paper was submitted for publication, an additional case of congenital obstruction of the duodenum and malrotation of the colon has been observed and treated surgically at the University Hospitals.

CASE III: A. J. N., a colored female infant, was born on Sept. 20, 1953. She was brought to the Out-Patient Department on Sept. 24, with a history of vomiting all breast feedings for the past two days. At times the vomitus contained bile. The child was referred to the x-ray department, where an upper gastro-intestinal series with Lipiodol swallow revealed a moderate dilatation of the second portion and the proximal part of the third portion of the duodenum. The Lipiodol was arrested at this level and trickled down slowly into the jejunum. A barium enema study at this same time showed the cecum to be situated in the right upper abdominal quadrant at the inferior surface of the liver, pointing medially and very close to the proximal part of the third portion of the duodenum. *Preoperative impression:* Congenital obstruction of the third part of the duodenum by peritoneal bands, with incomplete rotation of the colon.

Laparotomy, performed on the day of admission, revealed a 360° volvulus of the midgut in clockwise fashion; the cecum was fixed high in the right upper quadrant, with peritoneal bands extending to the duodenojejunal junction and from the cecum to the right lateral wall.

The bands were freed and the volvulus reduced. The colon was placed in the left side of the abdomen. The postoperative course was uneventful, and six months after surgery, when the patient was last seen, she had no symptoms referable to the gastrointestinal tract.

REFERENCES

1. BIRGFIELD, E.: Zur kongenitalen Dünndarmatresie. Zentralbl. f. Chir. **55**: 1548–1553, June 23, 1928.
2. BOLLING, R. W.: Complete Congenital Obstruction of the Duodenum. Duodeno-Jejunostomy at Nine Days. Ann. Surg. **83**: 543–544, April 1926.

3. BROWN, R. B., AND ROSS, D.: Congenital Abnormalities of Intestinal Rotation and Mesenteric Attachment. Cause of Intestinal Obstruction in an Adult. Ann. Surg. **134**: 88–98, July 1951.

4. CAFFEY, J.: Pediatric X-Ray Diagnosis: A Textbook for Students and Practitioners of Pediatrics, Surgery and Radiology. 2d ed. Chicago, The Year Book Publishers, 1950.

5. COHEN, P.: Congenital Intestinal Obstruction, with Special Reference to the Value of Plain Roentgenogram for Diagnosis. Am. J. Dis. Child. **61**: 135–149, January 1941.

6. DAVIS, D. L., AND POYNTER, C. W. M.: Congenital Occlusions of the Intestines, with Report of a Case of Multiple Atresia in the Jejunum. Surg., Gynec. & Obst. **34**: 35–41, January 1922.

7. DOTT, N. M.: Anomalies of Intestinal Rotation. Brit. J. Surg. **11**: 251–286, October 1923.

8. ISBISTER, C., AND GASTON, D.: Duodenal Obstruction Due to Congenital Anomalies. M. J. Australia **2**: 355–356, 1952.

9. LADD, W. E.: Congenital Duodenal Obstruction. Surgery **1**: 878–885, June 1937.

10. LADD, W. E.: Congenital Obstruction of Small Intestine. J.A.M.A. **101**: 1453–1458, Nov. 4, 1933.

11. LOCKARD, V. M.: Lesions of the Upper Gastro-Intestinal Tract in Infants and Children. Radiology **58**: 696–704, May 1952.

12. MELLINS, H. Z., AND MILMAN, D. H.: Congenital Duodenal Obstruction. Roentgen Diagnosis by Insufflation of Air. Am. J. Dis. Child. **72**: 81–88, July 1946.

13. MCINTOSH, R., AND DONOVAN, E. J.: Disturbances of Rotation of the Intestinal Tract. Clinical Picture Based on Observations in Twenty Cases. Am. J. Dis. Child. **57**: 116–166, January 1939.

14. MICHEL, M. L., JR., AND JARRELL, M. L.: Acute Intestinal Obstruction in Infants and Young Children. Am. Surgeon **17**: 1040–1056, November 1951.

15. MORETZ, W. H., AND MORTON, J. J.: Acute Volvulus of Small Intestine. Analysis of Thirty-six Cases. **132**: 899–912, November 1950.

16. ROGERS, J. D., BAGGENSTOSS, A. H., MUSGROVE, J. E., AND KENNEDY, R. L. J.: Intestinal Obstruction Associated with Fibrocystic Disease of the Pancreas. Report of Three Cases. Minnesota Med. **34**: 1075–1081, November 1951.

17. SAUNDERS, J. B. DEC. M., AND LINDNER, H. H.: Congenital Anomalies of the Duodenum. Ann. Surg. **112**: 321–338, September 1940.

18. SILVERMAN, F. N., AND CAFFEY, J.: Congenital Obstructions of the Alimentary Tract in Infants and Children: Errors of Rotation of the Midgut. Radiology **53**: 781–788, December 1949.

19. SPENCER, R.: Intestinal Obstruction Produced by Failure of Intestinal Rotation. Description of Case. Brit. J. Surg. **39**: 105–111, September 1951.

20. SWENSON, O., AND LADD, W. E.: Medical Progress. Surgical Emergencies of the Alimentary Tract of Newborn. New England J. Med. **233**: 660–663, Nov. 29, 1945.

21. WEBB, C. H., AND WANGENSTEEN, O. H.: Congenital Intestinal Atresia. Am. J. Dis. Child. **41**: 262–284, February 1931.

22. WHITE, C. S., AND COLLINS, J. L.: Congenital Duodenal Obstruction. Arch. Surg. **43**: 858–865, November 1941.

University Hospitals
800 Northeast 13th St.
Oklahoma City 4, Okla.

SUMARIO

Oclusión Congénita del Duodeno y Malarrotación del Colon

Présentanse 2 casos de oclusión congénita extrínseca de la porción distal del duodeno: uno en un recién nacido y el otro en un niño de trece años que había experimentado ataques intermitentes de vómitos y dolor abdominal desde la edad de dos semanas. Los dos enfermos manifestaban las mismas anomalías: defectuosa inserción mesentérica y malarrotación del colon, culminando en vólvulo del mesogastrio y obstrucción duodenal.

Estos casos representan a las claras un estacionamiento temprano de la rotación del mesogastrio en la vida fetal, probablemente entre la octava y la décima semanas del embarazo. En ambos casos, el ciego se hallaba en el hipocondrio izquierdo y el mesenterio primitivo existía todavía. Ambos enfermos tenían además persistentes bandas peritoneales anchas que provocaban constricción en la unión duodenoyeyunal. Un tercer factor que contribuía a la oclusión del duodeno era la compresión directa ejercida por el ciego distendido y en posición anormal.

Esta forma de oclusión puede ser diagnosticada radiológicamente con radiografías corrientes complementadas con el examen con un medio de contraste. Opínase que deben emprenderse estudios con enemas de bario en todo caso de problemática oclusión congénita del duodeno. La rectificación quirúrgica temprana y adecuada reviste importancia primordial.

Diaphragmatic Herniation of the Pancreas[1]

M. H. POPPEL, M.D., R. M. ABRAMS, M.D., J. HANDELSMAN, M.D., and A. SEGAL, M.D.

ALTHOUGH A REVIEW of the literature reveals occasional mention of herniation of the pancreas through the diaphragm, it fails to yield a single well documented example or any with roentgen visualization of the hernia. The case to be reported here is believed to be the first to be roentgenographically demonstrated. It points up two important facts: first, that a diaphragmatic hernia of the pancreas can be diagnosed prior to surgery or autopsy; second, that the pancreas is not a relatively fixed retroperitoneal viscus.

Fig. 1. Calcifications in the tail of the pancreas, indicated by the arrow.
Fig. 2. Pancreatic calcifications above the diaphragm (arrow), related to the ectopic positions of the stomach and duodenum.

CASE REPORT

A 62-year-old white woman was admitted to the hospital on Feb. 1, 1953, having suffered attacks of indigestion for twenty-five years. In the past two years these episodes had been more numerous and more severe, with frequent vomiting. In the few months immediately preceding admission the patient had experienced a sense of pressure in the pelvis.

The systemic review and past history, except for the attacks of indigestion, were non-contributory. There was no history of trauma. Physical examination revealed absence of breath sounds at the right base posteriorly, with tympany, and a large mass in the lower abdomen. The laboratory findings were not significant.

Roentgen examination of the chest showed loops of bowel in the right hemithorax. A gastrointestinal series disclosed an opening through the anterior portion of the diaphragm with herniation of the pars media, antrum, and pyloric portions of the stomach, the bulb, the pars superior and descendans of the

[1] From the Departments of Radiology of New York University Medical School and Wyckoff Heights Hospital, New York, N. Y. Accepted for publication in June 1953.

Fig. 3. Ectopic position of the descending duodenum.
Fig. 4. Calcifications in the tail of the pancreas as related to the cardiac end of the stomach.

duodenum, the jejunum, a segment of the colon and, possibly, the omentum. There was a resultant volvulus of the stomach. The pancreas participated in the herniation, as evidenced by the position of characteristic pancreatic calculi. Other roentgen findings were a large lower abdominal mass of pelvic origin and a gallbladder calculus.

The abdominal mass proved on exploratory laparotomy to be a large ovarian cyst measuring 22 × 14 × 10 cm., which was removed. A thickened gallbladder containing a single stone was also removed. The liver was rotated so that its left border was just to the right of the mid-line, but was otherwise normal. There was a defect in the diaphragm measuring 4 × 7 cm., situated about 5 cm. to the left of the mid-sternal line, with its anterior border 2 cm. from the sternal attachment of the diaphragm. Through this opening, and passing anteriorly along the pericardium to enter the right hemithorax, was a herniation of the stomach, small bowel, duodenum, transverse colon, omentum, and the pancreas, the last peppered with small calcifications. There was no hernial sac.

Reduction was easily effected, and the opening in the diaphragm was repaired. Recovery was uneventful.

DISCUSSION

Two assumptions appear logical in the case reported: in the first place, a congenital weakness at the point of the opening in the diaphragm, which probably was thinned and eventually torn through as a result of increasing abdominal pressure caused by the enlarging ovarian cyst, and in the second place, the presence of an old pancreatitis, probably of the relapsing variety, as indicated by the calcareous residua.

The pancreas is so intimately related, by virtue of the rather firm insertions of its main and minor ducts, to the vaterian papillary and supravaterian regions of the descending duodenum, that it may be postulated that displacement of the latter will be accompanied by pancreatic displacement or even herniation, beginning with the head.

The pancreas has also been found protruding through stab wounds in the abdomen, pulled down by heavy solid tumors, and in umbilical herniae of both the congenital and acquired types.

SUMMARY

What is believed to be the first example of herniation of the pancreas through the

diaphragm demonstrated roentgenographically is reported.

Because of the intimate relationship of the pancreas to the duodenum, it is postulated that herniation or displacement of the latter will be accompanied by similar herniation or displacement of the former.

REFERENCES

ARCHIBALD, E. W., AND KAUFMAN, M.: Surgical Diseases of the Pancreas. In Lewis's Practice of Surgery, Vol. VII, Hagerstown, Md., W. F. Prior Co., Inc., 1948.

HARRINGTON, S. W.: Roentgenologic Considerations in the Diagnosis and Treatment of Diaphragmatic Hernia. Am. J. Roentgenol. **49**: 185–195, February 1943.

HARRINGTON, S. W.: Diagnosis and Treatment of Various Types of Diaphragmatic Hernia. Am. J. Surg. **50**: 381–446, November 1940.

POPPEL, M. H.: Roentgen Manifestations of Pancreatic Diseases. Springfield, Ill., Chas. C Thomas, 1951.

POPPEL, M. H., and LEVY, A. H.: Pancreatic Lithiasis. Radiology **37**: 174–177, August 1941.

Bellevue Hospital Center
First Ave. and 27th St.
New York 16, N. Y.

SUMARIO

Hernia Diafragmática del Páncreas

Este parece ser el primer caso de hernia transdiafragmática del páncreas descubierto roentgenográficamente. El examen roentgenológico reveló una abertura en el diafragma, por la cual se habían herniado la parte media, el antro y la porción pilórica del estómago, el capuchón, la parte superior y la descendente del duodeno, el yeyuno y un segmento del colon. El páncreas participaba en la hernia, según demostraba la posición de cálculos pancreáticos.

Por virtud de la íntima relación del páncreas y el duodeno, se presupone que la hernia o desplazamiento del segundo irá acompañada de un desplazamiento o hernia semejante del primero.

En el caso presentado, se da por sentado un debilitamiento congénito del diafragma, con adelgazamiento y desgarro subsecuente a consecuencia del aumento de la presión intraabdominal debido a un quiste ovárico en vías de agrandamiento.

The Attenuation of Gamma Rays at Oblique Incidence[1]

F. S. KIRN, M.A., R. J. KENNEDY, Ph.B., and H. O. WYCKOFF, Ph.D.

THE HIGH COST and the heavy weight of barriers required for protection against high-energy roentgen or gamma rays warrant a detailed study of the factors involved in obtaining an economical solution to the protection problem. One factor which has had no detailed experimental or theoretical evaluation is the attenuation of radiation obliquely incident upon radiation barriers.

It is usually assumed (1) that radiation obliquely incident on a barrier is attenuated to the same extent as it would be when normally incident on a barrier whose thickness is equal to the slant distance through the oblique barrier. This assumption, however, may lead to a significant underestimate of the barrier thickness required to produce a specified attenuation. In most protection problems, scattered radiation makes an important contribution to the transmission of the barrier (2). When radiation is normally incident, the scattered radiation which emerges from the barrier must always travel a distance greater than that traveled by the unscattered radiation. In oblique incidence, however, some of the scattered radiation travels a much shorter distance than the unscattered radiation. In view of this, the assumption mentioned above may lead to estimates of barrier thickness that are too low.

The results given in this report indicate the errors that may be introduced. For purposes of discussion and presentation of results, it will be convenient to compare the attenuation experimentally determined for obliquely incident radiation with that computed from the attenuation curves obtained for normal incidence, assuming a barrier thickness equal to the slant thickness through the oblique barrier.

The experimental arrangement developed for the above problem was also used to determine the transmission characteristics of combination barriers which have special shielding properties. For example, since lead readily absorbs much of the radiation scattered in a low atomic number material, a relatively thin layer of lead on the emergent face of such material will greatly increase the attenuation of the combination. Although such effects can be predicted from theoretical considerations, no previous attempt has been made to evaluate them experimentally.

QUALITATIVE PREDICTIONS

A detailed theoretical study of the attenuation of obliquely incident radiation is now in progress at this laboratory and hence no attempt will be made to give a complete analysis of the problem. However, a simple qualitative discussion employing only single scattering is included in an appendix and will be helpful in visualizing the difference between the attenuation of normally and obliquely incident radiations. It is shown that for a given slant thickness one should expect for thin barriers a decrease in transmission for increasing angles of incidence and, conversely, for thick barriers an increase in transmission with increasing angles of incidence.

Qualitative predictions can be made regarding the variation of the obliquity effect with incident photon energy and atomic number of the absorbing medium. These predictions are possible since the effect arises from Compton scattered radiation and depends upon the relative importance of the Compton phenomenon with respect to the photoelectric process. The Compton scattered radiation carries a large

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[1] From the Radiation Physics Laboratory, National Bureau of Standards. Work supported by the Atomic Energy Commission.

Presented in part at the Thirty-eighth Annual Meeting of the Radiological Society of North America, Cincinnati, Ohio, Dec. 7 to 12, 1952.

fraction of the incident energy when the energy of the incident photons is rather low. The obliquity effect, therefore, tends to be increasingly important as the energy of the incident photons decreases. On the other hand, outright absorption by the photoelectric process tends to suppress the obliquity effect and becomes more important for low-energy photons, especially in materials of high atomic number. As a result, the obliquity effect should be most important in low-Z materials and at energies (above 50–150 kev) where the photoelectric effect is still unimportant. In materials of high atomic number the obliquity effect should become appreciable only at higher energies.

EXPERIMENTAL ARRANGEMENT

For most applications, roentgen-ray and gamma-ray sources are physically small, and the useful beam is limited to a diverging cone. Investigation of the obliquity effect, therefore, requires not only measurements of attenuation as a function of the angle of incidence but also as a function of the angles of the cone and the source-to-barrier distance. Some measurements of the obliquity effect were made for a wide-angled cone of radiation in a geometry which might be encountered in practice.

In order to reduce the number of relevant variables, however, and thus facilitate the interpretation of the results as well as their comparison with theory, the main experiment was designed for a related but simpler problem: the attenuation of an infinitely broad parallel beam of monoenergetic photons incident at various angles on a plane parallel barrier.

The attainment of such a plane parallel beam of gamma rays is almost impossible to achieve in practice.[2] There exists, however, an alternative arrangement that gives equivalent results—a pencil of radiation detected by an infinite plane detector behind the barrier. The two equivalent cases are illustrated in Figure 1. Let the intensity of incident radiation in these two geometries be the same. For each scattered ray, AD, in the geometry of Fig. 1*a*, there will be one and only one corresponding ray, $A'D'$, in the geometry of Fig. 1*b*. This one-to-one correspondence, when extended to other pairs of rays, establishes the equivalence of the two arrangements, and detectors D' and D should then measure the same quantity of radiation. Furthermore, it is clear that the measured per cent transmission by the barrier will remain the same if the incident radiation pencil is expanded in the vertical direction, making it into a vertical sheet, and if the plane detector is contracted in the vertical direction, transforming it into a horizontal strip. This latter arrangement, which was easier to realize physically, was adopted for this experiment (Fig. 2).

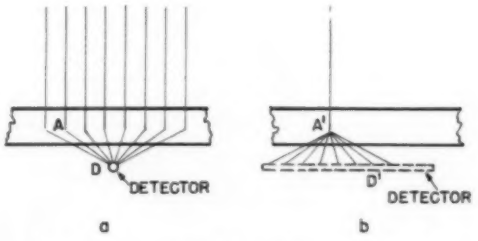

Fig. 1. Schematic view illustrating the one-to-one correspondence of scattered photons detected by two experimental geometries. *a*. Infinite plane parallel beam of radiation incident on a barrier with a point detector measuring the transmitted radiation. *b*. Pencil beam of radiation incident on a barrier with an infinite plane detector measuring the transmitted radiation.

The "sheet" of gamma-rays was formed by placing the source of gamma radiation at the end of a lead collimator whose opening was approximately 16 inches long, 8 inches high and 1/2 to 1/4 inch wide. The source-to-detector distance was 7 feet. This defined a beam 40 inches high at the plane of the detector. The dose rate in the vertical direction was uniform within ±3 per cent, and in the horizontal direction within ±2 per cent even at the extreme oblique

[2] The most obvious approach would be through the use of a point source at a distance far enough from the barrier to give essentially a uniform intensity across an area sufficiently large to meet broad beam requirements. Calculations show that the distance necessary to hold the dose rate uniform to within ±2 per cent over a 36-inch width at a 70° angle of incidence would be of the order of 140 feet, which is an entirely impractical length.

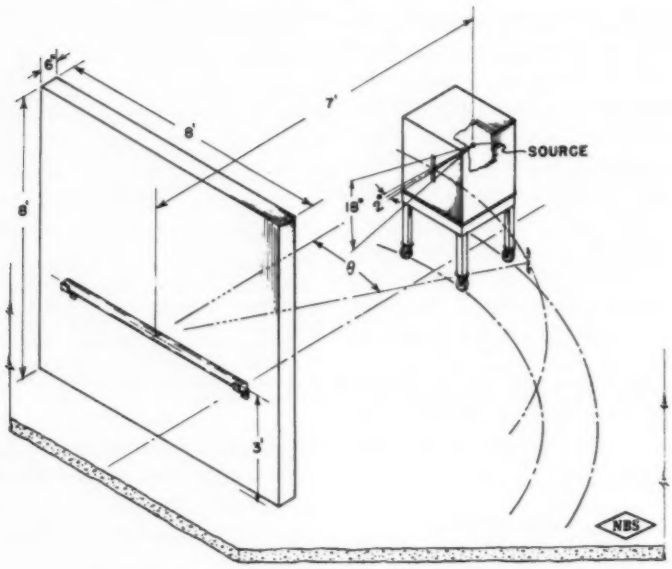

Fig. 2. Schematic drawing of experimental arrangement.

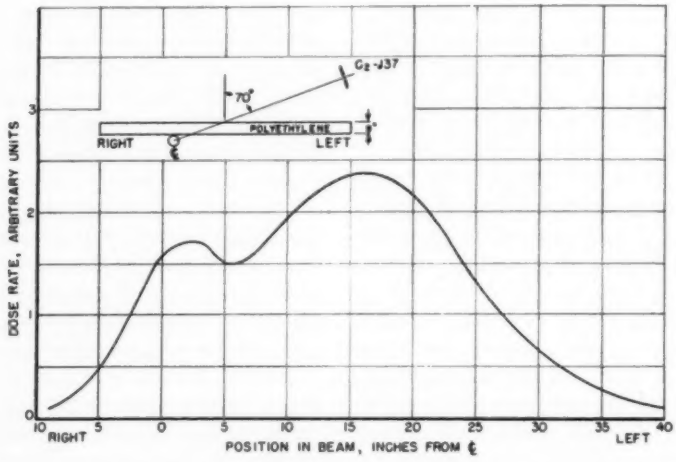

Fig. 3. Distribution of dose rate behind a 9-inch barrier of polyethylene for cesium-137 radiation incident at an angle of 70°.

angle of 70 degrees. The entire collimator and source were placed on a rolling table which could be rotated at a fixed radius about an axis through the center of the detector (Fig. 2). Data were obtained for each thickness of absorber at angles of incidence of 0°, 30°, 50°, 60°, and 70°.

The detector length required to obtain essentially all of the scattered radiation was determined by an auxiliary experiment. The readings of a small ionization chamber were obtained as a function of its position along the barrier. Sample results are shown in Figure 3 for polyethylene. (The small peak arises from the transmission of the primary beam; the higher peak arises from the scattered radiation.) It is seen that nearly all of the

radiation is collected within a distance of 50 inches.

The ionization chamber used in the attenuation experiments had a sensitive length of about 70 inches and was made from 1/8-inch wall Bakelite tubing having an O.D. of 1 1/2 inches. The inner surface was coated with a conducting layer of colloidal graphite (dag). The center electrode was an aluminum wire also coated with dag and supported at both ends with electrostatically shielded amber insulators. A collecting potential of 180 volts was sufficient for saturation. Chambers of this general type are energy-independent within 10 per cent for energies down to 150 kev (3). For the incident photon energies used in this experiment, the fraction of the transmitted dose contained in scattered radiation below this value is relatively unimportant.

The ionization current was measured by the use of a vibrating reed electrometer as a null indicator and a portable potentiometer to supply the bucking voltage. Calibrated resistors and capacitors were employed to give an adequate range of sensitivity.

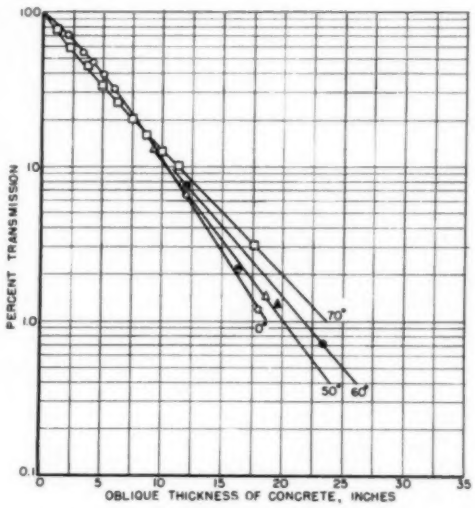

Fig. 4. Transmission of cobalt-60 radiation through concrete of density 147 #/ft.³ for indicated angles of incidence. Data are also indicated for a point source of diverging radiation at oblique angles of 44° (◓) and 64° (▲).

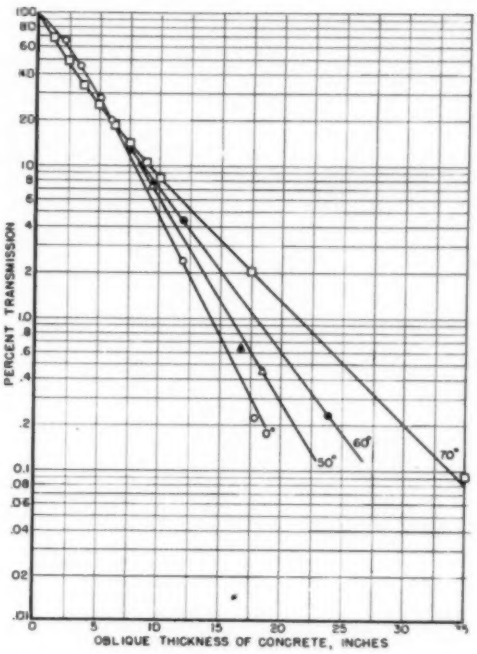

Fig. 5. Transmission of cesium-137 radiation through concrete of density 147 #/ft.³ for indicated angles of incidence. Data are also indicated for a point source of diverging radiation at an oblique angle of 60° (▲).

Lead, concrete, and polyethylene absorbers were the main objects of investigation. Lead and concrete are the most common protective materials of high and low effective atomic numbers, and polyethylene can be considered as a pure Compton scatterer throughout a range of energies from 0.05 to 2.0 mev. In one case barriers of aluminum and steel were also investigated. Composite barriers of lead and concrete or lead and polyethylene were studied to determine the effects of combining the two materials.

The lead absorbers were in sheets 4 × 8 ft. × 1/8 in., except for one sheet 4 × 8 ft. × 1/4 in. backed by 3/4-inch plywood. The wood-backed absorber served as a rigid support to which the other lead sheets could be clamped. Barriers of concrete were built up from slabs 8 × 8 ft. × 6 in., having a density 2.35 g./cm.³ (147-#/cu. ft.). Barriers of polyethylene were constructed from sheets 5 × 3 ft. × 1 in.

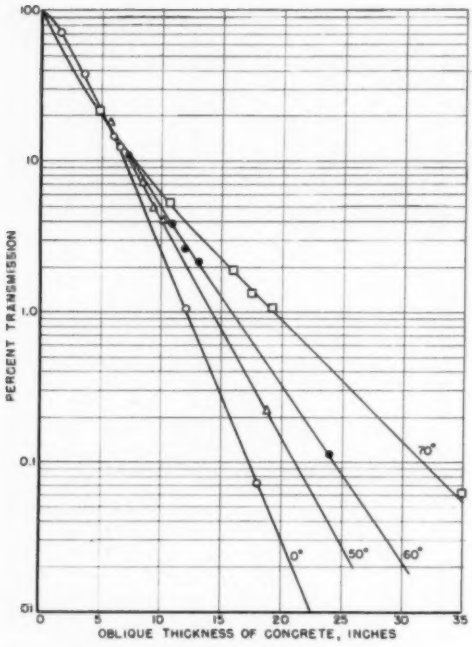

Fig. 6. Transmission of gold-198 radiation through concrete density 147 #/ft.³ for indicated angles of incidence.

and 3 × 3 ft. × 1 in., having a density 0.92, g./cm³.

The radiation from three gamma-ray sources was utilized: (*a*) a 3-curie cobalt-60 source with equal number of photons of 1.33 and 1.17 mev; (*b*) an 8-curie cesium-137 source with a gamma ray of 0.661 mev; (*c*) a 40-curie gold-198 source. This last source contains three distinct gamma rays with the following energies and relative number of photons (4): 0.411 mev, 0.982; 0.67 mev, 0.014; 1.09 mev, 0.004. Although the two higher-energy gamma lines in gold are much less intense than the 0.411-mev line, they are more penetrating and become relatively more important at great depths in the barrier.

RESULTS

Experimental attenuation curves for concrete and lead are shown in Figures 4 to 9 for gamma rays from cobalt 60, cesium 137, and gold 198. For each source and material an attenuation curve was obtained for 5 angles of incidence (0°, 30°, 50°, 60°, and 70°). In all cases, however, the 30° curve fell so close to the 0° curve that it has been omitted from the graphs. Data from zero thickness to the cross-over region at angles of 50° and 60° were also omitted, since there was insufficient room on the graphs between the 0°

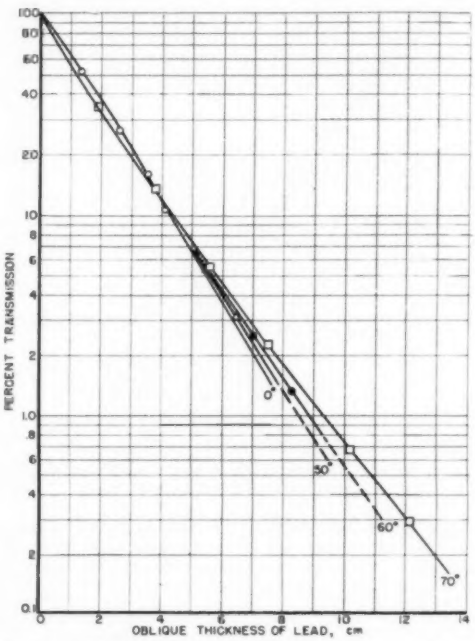

Fig. 7. Transmission of cobalt-60 radiation through lead for the indicated angles of incidence.

and 70° curves to show them clearly. The abscissa in all cases is the barrier thickness measured along the direction of the incident rays.

Figures 4, 5, and 6 are plotted for concrete having a density of 2.35 g./cm.³. Since the smallest thickness of concrete available was 6 inches, the values of per cent transmission for smaller thicknesses were plotted from the data obtained using thin sheets of "concrete-like" materials. Polyethylene was used for cobalt-60 and cesium-137 radiation; aluminum was used for gold 198. The polyethylene and aluminum thicknesses were reduced to the equivalent thickness of concrete in proportion to the relative electron densities of the materials. Since the Compton

scattering cross section for a given energy is a function of electron density only, this thickness reduction makes the measurements for the different materials rigorously equivalent in so far as the absorption is due to the Compton effect. When photoelectric absorption is included, the

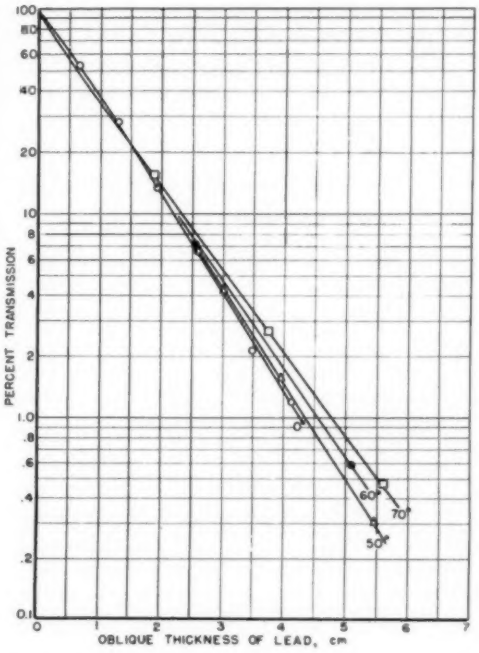

Fig. 8. Transmission of cesium-137 radiation through lead for the indicated angles of incidence.

aluminum and concrete absorption coefficients per electron remain essentially equal down to 50 kev. The polyethylene coefficient, however, departs from that of concrete below 200 kev because of the large differences in their photoelectric absorption.

The importance of the higher-energy photons (0.67 and 1.09 mev) from gold 198 depends upon how much their absorption coefficients differ from that of the 0.411-mev line and upon the thickness of the barrier. For large differences of absorption coefficient, or for large thicknesses of absorber, the slope of the attenuation curves should decrease. Since the absorption coefficients are not widely different for

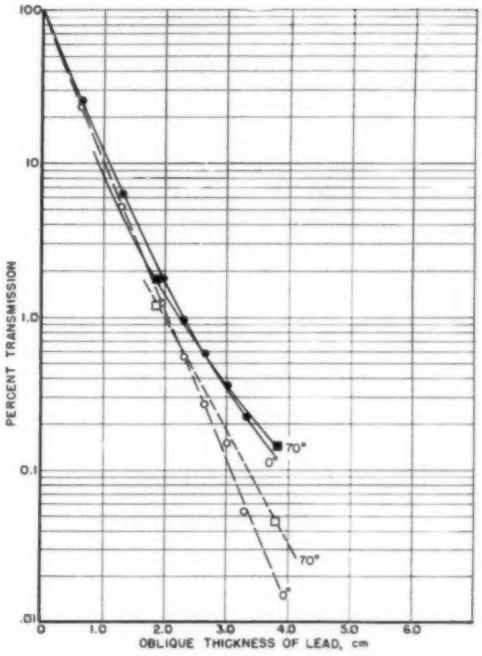

Fig. 9. Transmission of gold-198 radiation through lead for 0° and 70° angles of incidence. The dashed curves have been corrected for the presence of the 1.09 mev and 0.67 mev gold lines and hence are the transmission of the 0.411 mev line only. Solid curves are the uncorrected data.

concrete, it is not surprising that the slope does not change markedly for the largest barriers used. On the other hand, the coefficients are markedly different for lead, so that the change in slope indicated in the solid line curves of Figure 9 is expected. The experimental data on gold 198 can be corrected for the contribution of the higher-energy photons to obtain the attentuation of the 0.411-mev photons alone. Since the percentage of the total dose due to the higher-energy photons is known at zero thickness of barrier,[3] the per cent contribution can be determined at any depth by using the proper attenuation curves for those energies. The attenuation for lead at 0.67 mev was measured (Fig. 8); the attenuation curve for

[3] Several values for the relative intensities of these lines have been published, but the values given by Cavanagh (4) gave the best fit to our experimental data.

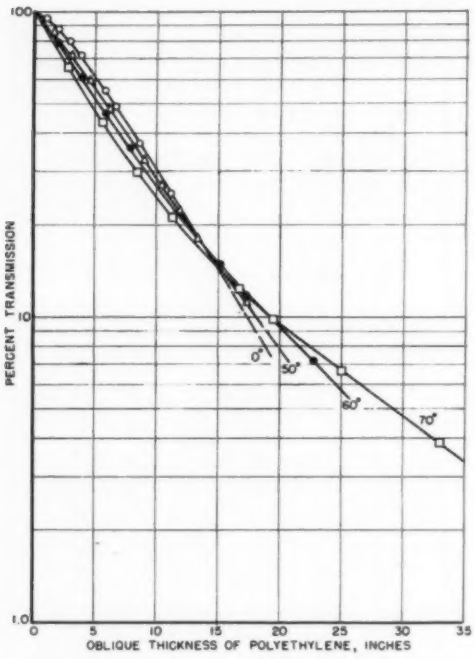

Fig. 10. Transmission of gold-198 radiation through polyethylene of density 0.92 g./cm.^{3} for the indicated angles of incidence.

the 1.09-mev photons can be approximated by using its narrow beam attenuation curve (μ = 0.13 cm.$^{-1}$) (5) and the build-up factor (6) at each level of attenuation obtained from the cobalt-60 data. The effect of the 0.67 and 1.09-mev photons may then be subtracted from the experimental data to obtain the attenuation due to the 0.411-mev photons only. The resulting curve is shown in Figure 9. Data on the absorption of gold-198 radiation in polyethylene are plotted in Figure 10.

Tables I and II illustrate the difference between the attenuation observed under oblique incidence and the attenuation expected on the basis of normal incidence data for a barrier thickness equal to the slant thickness. Table I gives the ratio of the observed to the estimated attenuation for fixed values of the latter. The tabular values thus indicate the error in dose rate which would be introduced by using the oblique ray path and the curves for normal incidence. For instance, if a transmission of 0.1 per cent is permitted, according to the National Bureau of Standards Handbook on Protection (1), for cesium radiation incident on a concrete wall at an angle of 60°, Table I indicates that the actual transmission is 5.2 times as much as that permitted. Table II indicates the barrier thicknesses required for desired attenuations according to actual observation and according to the approximate method outlined in the Handbook for several energies of incident gamma rays.

TABLE I

Dose rate (observed)*
Dose rate (estimated)

Per cent Transmission Estimated	50°		60°		70°	
	Concrete	Lead	Concrete	Lead	Concrete	Lead
			(0.411 mev)			
10	1.1		1.2		1.2	1.0
1.0	2.0		2.7		4.0	1.0
0.1	3.7		7.0		15	1.5
			Cesium 137 (0.661 mev)			
10	1.2	1.0	1.2	1.0	1.3	1.1
1.0	1.7	1.1	2.5	1.3	3.7	1.6
0.1	2.3	(1.2)	5.2	(1.7)	10.1	(2.4)
			Cobalt 60 (1.33 and 1.17 mev)			
10	1.0	1.0	1.0	1.0	1.2	1.1
1.0	1.4	1.1	1.9	1.3	2.5	1.6
0.1	(2.0)	(1.3)	(3.5)	(1.9)	(5.6)	(2.8)

* This is the ratio of the dose rate as measured experimentally for oblique angles to that which is determined from normal incidence attenuation data for thickness of barrier equal to the slant thickness in the oblique barrier. Values in parentheses are obtained by linear extrapolation of curves.

From Tables I and II or from Figures 4 to 10 it can be seen that the differences in the two methods of computation are greatest for the lowest energy used here (0.411 mev) with low atomic number barriers and decrease with increase of energy. On the other hand, the results for high atomic number show an opposite energy dependence. In addition, the differences are smaller for high atomic number. These effects are in agreement with the qualitative predictions.

Representative data obtained with a conical beam of diverging radiation are also given in Figures 4 and 5. For these re-

sults, the point source of radiation was collimated to give an irradiated area at the barrier of 36 inches diameter (normal incidence) with the source-to-barrier distance fixed at 10 feet for all angles of incidence. From these figures, it can be seen that the obliquity effect is less for conical radiation than for plane parallel radiation. For transmissions of 1.0 per cent, the difference in thickness between the experimental and calculated values is less than 10 per cent at angles of obliquity of 64° for cobalt-60 and cesium-137 radiation, and less than 6 per cent at 44° for cobalt-60 radiation.

TRANSMISSION THROUGH COMPOSITE BARRIERS

Figures 11 to 13 give the transmission of radiation incident normally on composite barriers of polyethylene backed by lead. The ordinate of these curves equals the transmission through the composite barrier (polyethylene and lead) divided by the transmission through the lead alone. The narrow beam transmission of the polyethylene is also indicated. The difference between the result for the composite barrier and for narrow beam conditions is a measure of the amount of scattered radiation (build-up) transmitted by the composite barrier. It is seen that little of the scattered radiation from 0.411-mev and 0.671-mev photons is transmitted by even thin layers of lead. On the other hand, lead does not absorb much of the scattered radiation from cobalt 60. Because of the increased importance of the photoelectric effect at low energies, these results are expected.

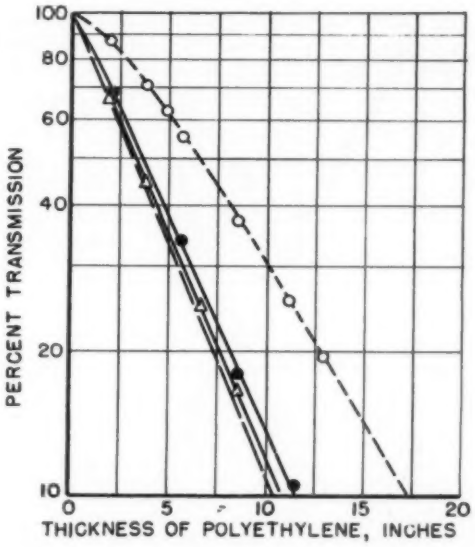

Fig. 11. Transmission of gold-198 radiation through polyethylene backed by 1/4 inch of lead (black dots) and 1/2 inch of lead (triangles) for normally incident radiation. Narrow beam data (long dash curve) and unbacked polyethylene data (short dash curve) are also indicated.

TABLE II: COMPARISON OF BARRIER THICKNESS FOR A DESIRED ATTENUATION DETERMINED FROM ESTIMATED AND EXPERIMENTAL DATA*

Per Cent Transmission	50°				60°				70°			
	Concrete (in.)		Lead (cm.)		Concrete (in.)		Lead (cm.)		Concrete (in.)		Lead (cm.)	
	Est.	Exp.	Est.	Exp.	Est.	Exp.	Est.	Exp.	Est.	Exp.	Est.	Exp.
					0.411 mev							
10	4.4	4.8			3.4	3.9			2.3	2.7	0.34	
1.0	7.8	9.1			6.1	7.9			4.1	6.6	0.72	0.68
0.1	11.1	13.6			8.7	12.2			5.9	10.8	1.1	1.2
					Cesium-137							
10	4.7	5.0	1.5	1.5	3.9	4.2	1.1	1.1	2.7	3.1	0.8	0.8
1.0	9.2	10.2	2.8	2.8	7.1	9.0	2.1	2.3	4.9	7.4	1.5	1.6
0.1	13.3	15.0	4.1	(4.1)	10.3	13.8	3.2	(3.4)	7.1	11.6	2.2	(2.5)
					Cobalt-60							
10	6.7	6.6	2.7	2.7	5.2	5.3	2.1	2.1	3.6	3.9	1.5	1.5
1.0	12.0	12.9	5.3	5.4	9.1	10.9	4.1	4.4	6.4	8.1	2.8	3.2
0.1	17.3	(19.2)	7.8	(8.1)	13.5	(16.4)	6.1	(6.7)	9.2	(12.4)	4.2	(5.0)

* The estimated data were obtained from the experimentally determined attenuation with normally incident radiation and for a barrier thickness equal to the slant thickness AB of Fig. 14. The experimental data were obtained for radiation incident obliquely on the barrier. Values in parentheses were obtained by linear extrapolation of curves.

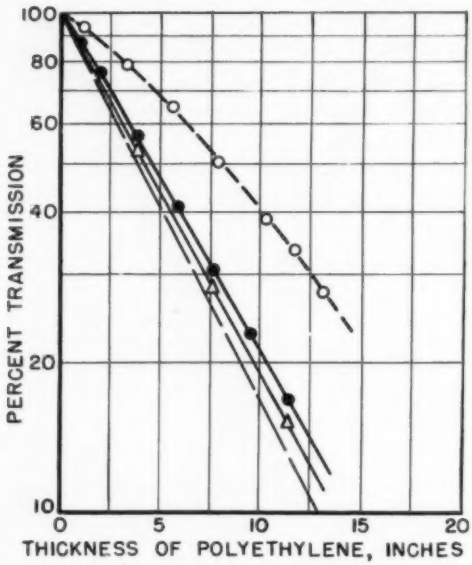

Fig. 12. Transmission of cesium-137 radiation through polyethylene backed by 1/4 inch of lead (black dots) and 1/2 inch of lead (triangle) for normally incident radiation. Narrow beam data (long dash curve) and unbacked polyethylene data (short dash curve) are also indicated.

SUMMARY

Attenuation data have been taken for radiation incident obliquely upon barriers of lead, concrete, or concrete-equivalent material. The gamma radiation from cobalt 60, cesium 137 and gold 198 was used at angles of incidence 0°, 30°, 50°, 60°, and 70°. The results show that for oblique angles of incidence the Compton scattered radiation may have shorter path lengths through the barrier. For the larger angles of incidence, the obliquity effect must be considered in designing barrier requirements. For a diverging cone of radiation, the effect is not too significant for attenuations less than 100. It is also shown that, in the range of energies below 0.7 mev, the addition of a layer of lead behind a low atomic number barrier can be effective in reducing the thickness requirements of the barrier.

APPENDIX

A simple qualitative picture of the relative path lengths of the scattered radiation and their relative contribution to the transmission in normal and oblique barriers can be obtained by considering ray AB in Figure 14 obliquely incident at an angle θ on a barrier of thickness t. The dotted lines through A and B and perpendicular to the ray indicate an assumed barrier of thickness $AB = t/\cos\theta$, which is equal to the slant thickness through the oblique barrier.

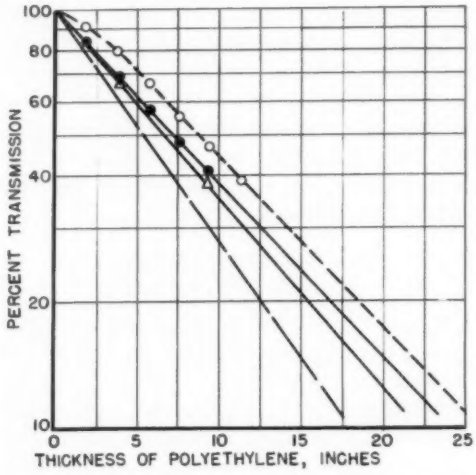

Fig. 13. Transmission of cobalt-60 radiation through polyethylene backed by 1/4 inch of lead (black dots) and 1/2 inch of lead (triangles) for normally incident radiation. Narrow beam data (long dash curve) and unbacked polyethylene data (short dash curve) are also indicated.

The attenuations in the two cases are to be compared. Let P be any scattering point in the material and consider photons scattered at an angle α. Since scatterings at all azimuths are equally probable, an equal amount of this scattered radiation will go to the left and to the right of a plane through AB and perpendicular to the drawing. We shall first examine the relative attenuations along two paths which are symmetrically placed with respect to the median plane just mentioned. It is evident that photons scattered at P toward S will be more strongly attenuated in the oblique barrier than in the normal barrier. Similarly, the attenuation along PMN is less in the oblique barrier than in the normal barrier. Thus, to compare the attenuations in the oblique and normal barriers, it is necessary to determine the loss in scattered radiation due to the added distance RS and the gain in radiation due to the distance MN. For small values of MN and RS, it can be shown that the attenuation in the normal barrier is less than in the oblique barrier by an amount proportional to $\mu\ (RS - MN)$. Since RS is always greater than MN, there is less penetration in the oblique case than in the normal.

On the other hand, if the scattering takes place well in front of the exit surface of the barrier, the

gain in transmission along PN may more than compensate for any loss along PS. Specifically this will be true when MN is equal to or greater than one half-value layer, in which case the probability of penetration along that ray will be increased by a factor of two or more. This will more than compensate for all the photons which are lost, due to the increase in path length for the corresponding ray on the other side of the median plane.

Thus, for a given angle of incidence (θ in Fig. 14), and for a given pair of rays, PRS and PMN, the attenuation in the oblique barrier can be more or less than in the normal barrier, depending on how far the point P is from the exit surface. This argument can be extended to any other pair of paths symmetrically placed with respect to the median plane. If an average attenuation is taken over scattering points, P, and over the possible range of scattering angles, the oblique barrier should show more attenuation than the normal barrier for thin barriers, and the situation should reverse itself at sufficiently large thicknesses. Since the difference between RS and MN increases with the angle of obliquity, θ, one would expect larger effects at larger angles of θ.

Radiation Physics Laboratory
National Bureau of Standards
Washington 25, D. C.

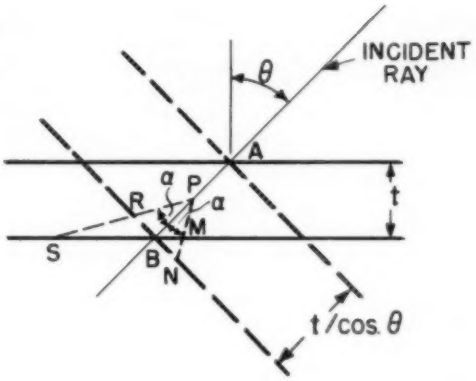

Fig. 14. Comparison of path lengths for photons which are scattered at some point P through an angle α in an oblique barrier (solid line) and in a normal barrier (dashed line). The comparison is made for two barriers which have the same effective thickness AB through the barrier for the unscattered incident photons. Path lengths through the oblique barrier are indicated by APM and APS, and the corresponding lengths through the normal barrier by APN and APR.

REFERENCES

1. X-Ray Protection Design. National Bureau of Standards Handbook 50.
2. WYCKOFF, H. O., KENNEDY, R. J., AND BRADFORD, W. R.: J. Research, NBS **41**: 223, 1948.
3. X-Ray Calibration of Radiation Survey Meters, Pocket Chambers, and Dosimeters. National Bureau of Standards Circular 507, April 1951.
4. CAVANAGH, et al.: Proc. Phys. Soc. Lond., A64, **13**: 1951.
5. WHITE, G. R.: Personal communication.
6. FANO, U.: Gamma-Ray Attenuation. Nucleonics **11**: 55–61, September 1953.

SUMARIO

La Atenuación de los Rayos Gamma en Incidencia Oblicua

Se han obtenido datos relativos a la atenuación de los rayos gamma procedentes del cobalto^{60}, del cesio^{137} y del oro^{198} para varios ángulos de incidencia de la radiación a una valla protectora. Se han investigado ángulos de 0°, 30°, 50°, 60° y 70°, medidos desde lo normal, para vallas compuestas de hormigón, polietileno, y plomo. Para vallas de gruesos de más de 3 C.H.R. y ángulos superiores a 30°, la atenuación resultó ser notablemente menor de lo esperado a base de la penetración con una incidencia normal. Se llevó a cabo un experimento separado para estudiar la penetración a través de vallas compuestas de substancias eficaces de números atómicos altos y bajos. Descubrióse que las vallas compuestas encuentran aplicación en una región de irradiación de energía limitada.

DISCUSSION

E. Dale Trout, B.S., Sc.D. (Milwaukee, Wis.): It is a real pleasure to be asked to discuss a paper by Dr. Wyckoff and his associates. Well in advance of the meeting I received a copy of the paper, complete with charts, and that in itself is an indication of a good piece of work, which this one certainly is.

A friend of mine who heads a university physics department says he has developed an unbeatable philosophy regarding the preparation and presentation of scientific papers. He says they should be looked upon as a penance by the author and a hair shirt by the listeners. I am sure that all of us who have ever attempted a task such as this

understand the penance performed by Doctor Wyckoff and his associates. The hair shirt is to be worn by those of us who have been living in a complacent glow after having designed installations with safety factors of 2 or 3. All of us are going to look more carefully at those installations where beams are going to be directed at oblique angles to the wall.

During the past year we have been examining concrete protective barriers in the 75 to 250-kv. range. At angles up to 45° and voltages up to 250 kv. we have not found much difference in attenuation between incident and oblique beams. We have not been able to use fields as large as those used by Dr. Wyckoff and our ionization chambers have been too small to get data comparable to his.

We have been interested in what happens to quality and intensity in the region immediately behind a concrete barrier. With the use of a small chamber the intensity is almost twice that predicted by inverse-square computations. As the distance from the barrier increases, the measured data become compatible with the computed values. The radiation behind the barrier decreases in penetration for a short distance as the chamber is moved away from the barrier, rises slowly, and reaches a constant at about the distance at which measured and computed intensities come into agreement. Dr. Wyckoff's work provides a much better understanding of these effects. He and his associates are to be congratulated on a fine piece of work.

In closing, one question: To what extent must we consider this effect at lower energies, say 250 kv., where concrete floors of therapy rooms may be exposed to large fields at angles rarely in excess of 45°?

Dr. Wyckoff: The indications are, from our work with cesium and cobalt, that at 45° the obliquity effect would be relatively unimportant. We expect the effect for concrete to increase with decrease in energy below 660 kev. We are not sure how large this effect will become or at what energy the maximum effect will occur. I believe it will be below the cesium point.

George G. Manov, Ph.D. (Oak Ridge, Tenn.): At large angles, how much of the gamma radiation was reflected directly from the incident surface.

Dr. Wyckoff: I don't have any figures on small beams of radiation. We are just getting some information on open sources which will be available. It is on the order of a few per cent, depending somewhat upon the angle of incidence.

Dr. Manov: Apparently your scattering is small.

Dr. Wyckoff: Yes.

T. N. White, Ph.D. (Los Alamos, N. M.): Dr. Wyckoff, I would like to understand this. Are these measurements all for what you might call a pure geometrical situation, so that in some cases you might have situations where the person behind the barrier would be affected by scattered radiation from perpendicularly transmitted radiation, as well as oblique radiation?

Dr. Wyckoff: Usually when you design a building you consider the beam going through a barrier at all possible angles. For the normal incidence you require a certain thickness. If the radiation source can be rotated so that the beam strikes the barrier obliquely, then you can reduce the thickness at that point.

These data indicate the thickness required for oblique radiation. They do not include the effect of angularity or beam spread, because we have used essentially parallel beams of radiation.

A Chemical Method for Determining the Activity of Developer Solutions[1]

MARTIN CHANIN, Ph.D.,[2] and FREDERICK H. BARNES[3]

IN ANY X-RAY department it is necessary to know the activity of the developer solution. Up to now, determination of this activity has been based largely on guesswork. Any methods approaching accuracy have been costly and highly technical.

An example of the latter procedures is that entailing exposure in a sensitometer and development and fixation by standard methods. The resulting film is then measured with a densitometer, and D/E curves are plotted (1, 2, 3). The disadvantages of this system are: that the time required is at least one hour; that during this hour the activity of the developer changes; that costly and complicated equipment is necessary and trained personnel is needed. It is evident that only the largest x-ray departments could supply the equipment and personnel.

The following method has been developed at the University of Michigan Hospital. It can be used by unskilled personnel after a small amount of instruction; only a short time is required for each determination; and the equipment is inexpensive. The materials needed are one 50-c.c. burette, one 3-c.c. pipette, one 250-c.c. Erlenmeyer flask, 0.1 normal iodine solution, and starch indicator solution.

Three cubic centimeters of freshly prepared developer solution are measured (with the pipette) into the 250-c.c. Erlenmeyer flask. Fifty cubic centimeters distilled water and about 5 drops of starch indicator solution are added to the developer, and the mixture is titrated with 0.1 normal iodine solution until the first permanent blue color appears. (The color change is very abrupt.) The computation

$$\frac{\text{c.c. (of iodine solution)} \times \text{normality (of iodine solution)}}{\text{c.c. (of developer solution)}}$$

gives a number that can be called the iodine value of the developer (I.V.D.). The I.V.D. of different brands and formulae of developer will not be constant, because it is a measure of the reducing power of the compounds used to make up the solutions. It does, however, supply a number that is characteristic of a specific developer, and as long as this developer is used, it can serve to determine the amount of replenisher that must be added. The most uniform results in developing will be obtained if the I.V.D. is kept at the value obtained with fresh developer. At the present time it is found that replenishing at the rate of 43 c.c. per hangette maintains this desired equilibrium.

Whenever it becomes necessary to determine the activity of the hypo solution, exactly the same method can be used. Both the developer solution and the hypo are chemical reducing agents, so they will react in the same way toward the iodine solution, which is an oxidizing agent. The starch indicator solution serves to show the presence of excess iodine.

College of Pharmacy
Detroit Institute of Technology
Detroit, Mich.

REFERENCES

1. HENNY, G. C.: Determination of the Potency of X-Ray Developer. Radiology **22**: 505–507, April 1934.
2. HODGES, P. C.: Radiology in the University of Chicago Clinics. Hospital Management **72**: 120, July 1951; 86, August 1951; 126, September 1951.
3. CHAMBERLAIN, W. E., AND NEWELL, R. R.: Development of Roentgen Films; A Method of Determining the Potency of the Developer. Am. J. Roentgenol. **23**: 549–552, May 1930.
4. MORGAN, R. H., AND VAN ALLEN, W. W.: The

[1] Accepted for publication in June 1953.
[2] Associate Professor of Chemistry, Detroit Institute of Technology, Detroit, Mich.
[3] Department of Radiology, University of Michigan Hospital, Ann Arbor, Mich.

Sensitometry of Roentgenographic Films and Screens. Radiology **52**: 832–845, June 1949.
5. MEES, C. E. K.: Theory of Photography. Encyclopedia Britannica, Fourteenth Edition. Vol. 17, pp. 807–814.
6. WILSEY, R. B.: The Laws of Development of X-Ray Films. Radiology **5**: 237–244, September 1925.
7. CHAMBERLAIN, R. H.: The Place of Physics in Clinical Radiology. The Carman Lecture. Radiology **60**: 331–347, March 1953.

SUMARIO

Método Químico para Determinar la Actividad de las Soluciones de Reveladores

Se ha elaborado un sencillo método químico para determinar la actividad de las soluciones de reveladores. A 3 c.c. de solución de revelador recién preparada en un balón de Erlenmeyer, se agregan 50 c.c. de agua destilada y unas 5 gotas de solución de indicador de almidón. Titúlase la mezcla con 0.1 por ciento de solución de yodo normal hasta que aparezca (muy repentinamente) la primera coloración azul permanente. El valor de yodo del revelador (obtenido multiplicando el número de centímetros cúbicos de solución de yodo por la normalidad de la solución de yodo y dividiendo el producto por el número de centímetros cúbicos de solución de revelador) permanece constante para un revelador dado y sirve para determinar la cantidad de repuesto que hay que agregar al mismo, la cual varía para las distintas marcas y fórmulas de reveladores.

EDITORIAL

Roentgen Therapy in Lepromatous Leprosy

In our everyday routine of radiological practice, it is uncommon for us to consider the possibility of seeing leprosy. Even less is the frequency with which we are confronted with the problem of its treatment.

In this issue of RADIOLOGY (page 1) there appears an article on the effect of roentgen rays on lepromatous leprosy, which not only reviews the effects of radiation in that disease, as reported in the literature, but also reports the authors' own experience with its radiation therapy. Perhaps for the first time, a scientific and quantitative approach is made toward the question of the amount of radiation which is necessary to control these lesions.

In reviewing the literature on the treatment of leprosy, it is interesting to note that, in 1901, Sequeira first reported on the use of roentgen rays and stated that these were not curative, but offered a means of making the lesions so treated quiescent. In 1906, Wilkinson, a physician in charge of the San Lazaro Hospitals in Manila, published a report in the *Journal of the American Medical Association* which is worthy of study by all who are interested in the radiation treatment of leprosy. Indeed, this was so impressive an article that at one time it was considered re-publishing it in RADIOLOGY.

Fortunately, leprosy occurs rarely in the United States but, from biblical times on, there have been numerous cases throughout the world, and today, even though the cause is well delineated, it remains a disease which deserves our utmost consideration, since we now have a means of controlling the local lesions.

The etiology of leprosy is well known, but the method of spread has long been a matter of conjecture. However, according to the June 27, 1953, issue of *Science News Letter*, quoting the work of Col. Edward A. Cleve and Col. Francis W. Pruitt of the Letterman Army Hospital in San Francisco, the ancient custom still practiced by the Buddhists, of shaving the heads of newborn babies to prevent spread of the disease has provided a clue to the problem. Leprosy is contracted by an infant through skin-to-skin contact with a leprous person. These authorities state that the germs of leprosy must at some time leave the patient's body through the sweat glands. Heads shaved of their protective hair, and inevitably nicked and cut from time to time during the shaving, would give ready entrance to large numbers of the germs from an infected grown person. They believe that the way to control leprosy is to separate the leprous person from the infant or child.

Dr. Lutterbeck and his associates are to be congratulated on their article and it is hoped that further research may be carried on with radiation. Perhaps the most interesting problem which confronts us at the present time is to determine the dosage of radiation necessary to completely inactivate the *Bacillus leprae*. The review of four years of progress is indeed interesting, and it is gratifying to see the improvement in the scientific approach to the treatment of this disease.

HUGH F. HARE, M.D.
Los Angeles, Calif.

ANNOUNCEMENTS AND BOOK REVIEWS

ARIZONA RADIOLOGICAL SOCIETY

The newly elected officers of the Arizona Radiological Society are: President, Walter T. Hileman, M.D., of Tucson; Vice-President, John W. Kennedy, M.D., of Phoenix; Secretary-Treasurer, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY

At the May meeting of the Connecticut Valley Radiological Society, the following were elected to serve for the ensuing year: Charles C. Verstandig, M.D., New Haven, Conn., President; Arthur J. Horrigan, M.D., Springfield, Mass., Vice-President; B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass., Secretary-Treasurer.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY

At the Annual Meeting of the Detroit Roentgen Ray and Radium Society, Dr. James C. Cook was elected President; Dr. Eugene M. Savignac, Vice-President; Dr. E. F. Lang, Harper Hospital, Detroit 1, Secretary-Treasurer.

LOS ANGELES RADIOLOGICAL SOCIETY

Officers of the Los Angeles Radiological Society recently elected to serve for the year September 1954–September 1955 are as follows: President, M. M. Haskell, M.D., Long Beach; Vice-President, George Jacobson, M.D., Los Angeles; Secretary, Oscar Harvey, M.D., 3741 Stocker St., Los Angeles 8; Treasurer, Hubert J. Prichard, M.D., Long Beach. Dr. Joseph F. Linsman of Beverly Hills was elected to the Executive Committee.

MARYLAND RADIOLOGICAL SOCIETY

The Second Annual Meeting of the Maryland Radiological Society was held in Hagerstown, Md., in conjunction with the Radiological Section of the Baltimore City Medical Society, on May 15. Dr. Ralph E. Lapp, Director of the Nuclear Science Service, Washington, D. C., was the guest speaker, taking as his subject "Atomic Defense."

Officers elected at the meeting were: E. Thrall Campbell, M.D., of Hagerstown, President; Webster H. Brown, M.D., of Baltimore, Vice-President; Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17, Secretary-Treasurer.

RADIOLOGICAL SOCIETY OF NEW JERSEY

The newly elected officers of the Radiological Society of New Jersey are: President, Dr. Nicholas G. Demy, Plainfield; Vice-President, Dr. Salomon Silvera, Jersey City; Treasurer, Dr. Leonard S. Ellenbogen, Atlantic City; Secretary, Dr. Carye-Belle Henle, 195 N. Seventh St., Newark.

OKLAHOMA STATE RADIOLOGICAL SOCIETY

At a meeting of the Oklahoma State Radiological Society held May 9, 1954, the following officers were elected: John R. Danstrom, M.D., Oklahoma City, President; Sol Wilner, M.D., Tulsa, Vice-President; Bert E. Mulvey, M.D., 1111 N. Lee, Oklahoma City, Secretary-Treasurer.

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY

The Seventh Annual Meeting of the Pacific Northwest Radiological Society was held in Harrison Hot Springs, British Columbia, May 13–16, under the direction of the President, Dr. William Sloan of Vancouver, B. C. Dr. D. R. McRae of Montreal was the guest speaker. Dr. Melvin Aspray of Spokane was installed as President. Newly elected officers are: Dr. Sydney J. Hawley, Seattle, President-Elect; Dr. J. S. Madill, Vancouver, B. C., First Vice-President; Dr. Milo Harris, Spokane, Second Vice-President; Dr. J. Richard Raines, 214 Medical Dental Bldg., Portland 5, Ore., Secretary-Treasurer. The Annual Meeting for 1955 will be held in Spokane.

THE RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA

At the May 1954 meeting of the Radiological Society of Southern California, the following officers were elected for the year 1954–55, to take office in June 1954: Chairman, James T. Case, M.D., Santa Barbara; Vice-Chairman, Lowell S. Goin, M.D., Los Angeles; Secretary-Treasurer, George Jacobson, M.D., Box 146, 1200 N. State St., Los Angeles 33. Other members of the Board of Governors are: John D. Camp, M.D., Los Angeles, and Donald R. Laing, M.D., Pasadena.

OHIO STATE RADIOLOGICAL SOCIETY

At the Annual Meeting of the Ohio State Radiological Society, held in Toledo, May 21–23, the following were elected to office for the ensuing year: Dr. Willis S. Peck, of Toledo, President; Dr. George R. Krause, of Cleveland, Vice-President; Dr. Paul A. Jones, of Zanesville, Treasurer; Dr. M. M. Thompson, Jr., 319 Toledo Medical Bldg., Toledo 2, Secretary.

The next Annual Meeting of the Society will be held in May 1955 in Akron, Ohio.

LECTURESHIP TO HONOR DR. ROSS GOLDEN

The first annual Ross Golden Lecture was delivered on April 19 at the New York Academy of Medicine by Dr. Leo G. Rigler, Professor and Chairman of the Department of Radiology, University of Minnesota. Dr. Rigler's subject was "Roentgen Observations on the Natural History of Carcinoma of the Lung."

The lectureship honoring Dr. Golden, who is retiring as Director of the Radiological Service of the College of Physicians and Surgeons, Columbia University, was made possible by the contributions of some 400 radiologists and workers in allied fields. It is sponsored by the University. On the occasion of the initial lecture, Dr. Golden was presented with a "manuscript of appreciation" of his achievements as diagnostician, lecturer, author, and editor, and as "one of the first to recognize the need for specialization within Radiology."

THE JANEWAY MEDAL AWARDED TO LAURISTON S. TAYLOR

The Janeway Medal, awarded annually by the American Radium Society for outstanding achievement in the field of applications of penetrating radiations in medical science, has this year been presented to Dr. Lauriston S. Taylor, who was cited for his participation in the development of the National Bureau of Standards radiation physics program, his contributions toward the development of international standards for radiation protection and radiation units, and his leadership in radiation protection through chairmanship of the National Committee on Radiation Protection in this country.

In Memoriam

DARMON A. RHINEHART, M.D.

Dr. Darmon A. Rhinehart of Little Rock, Ark., Professor Emeritus of Radiology at the University of Arkansas School of Medicine, died on May 28, at his home.

Dr. Rhinehart was born in Indiana in 1887. He received his Bachelor's, Master's, and Doctor's degrees from Indiana University and served as instructor in anatomy at that institution before moving to Little Rock, where he became head of the Department of Anatomy in the University of Arkansas. Later he established the Department of Radiology in the University and for a time continued to teach both subjects.

Dr. Rhinehart's association with the Radiological Society of North America covered a period of thirty years. He was a Past President of the Arkansas Medical Society; Chairman of the Section of Radiology of the Southern Medical Association; a Diplomate of the American Board of Radiology; a Fellow of the American College of Radiology; and a Past President and Member of the Board of Trustees of the American Registry of X-Ray Technicians. His manual on *Roentgenographic Technic*, first published in 1930, has only recently gone into a fourth edition. Beside his professional affiliations, Dr. Rhinehart was a member of the Free and Accepted Masons, Consistory, Scimitar Shrine, Rotary, Country Club, and Riverdale Club, all of Little Rock.

Darmon A. Rhinehart, M.D.

Both in the practice of his specialty and as a teacher, Dr. Rhinehart made a firm place for himself. For the years that strength remained to him he gave valuable service in both fields. The distinction that he won in the branch of medical science to which he devoted himself is impressively told by the honors that came to him. His passing is a loss to the medical profession and to the citizenship of Little Rock.

IRA H. LOCKWOOD, M.D.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

HISTOPATHOLOGIC TECHNIC AND PRACTICAL HISTOCHEMISTRY. By R. D. LILLIE, A.B., M.D., Medical Director, U. S. Public Health Service; Chief, Pathologic Anatomy Service, Clinical Center, National Institutes of Health; Chief,

Laboratory of Pathology and Pharmacology, National Institute for Arthritis and Metabolic Diseases. A volume of 501 pages with 30 tables. Published by The Blakiston Company, Inc., New York, N. Y., 1954. Price $7.50.

PHYSICAL ASPECTS OF BETATRON THERAPY. By JOHN S. LAUGHLIN, Associate Professor of Biophysics, Cornell University Medical College, Sloan-Kettering Division and Department of Physics, Memorial Center for Cancer and Allied Diseases, New York City; Formerly Associate Professor of Radiology, University of Illinois College of Medicine, Chicago. A monograph of 98 pages with 34 illustrations and graphs and 11 tables. Published by Charles C Thomas, Springfield, Ill., 1954. Price $3.75.

A PRIMER OF PULMONARY FUNCTION. By HAROLD GUYON TRIMBLE, M.D., and JAMES KIERAN, M.D., Oakland, Calif. A pamphlet of 22 pages. Printed through the cooperation of California Tuberculosis and Health Association, 1954.

ENDEMIC GOITER. THE ADAPTATION OF MAN TO IODINE DEFICIENCY. By JOHN B. STANBURY, M.D., GORDON L. BROWNELL, Ph.D., DOUGLAS S. RIGGS, M.D., HECTOR PERINETTI, M.D., JUAN ITOIZ, Ph.D., and ENRIQUE B. DEL CASTILLO, M.D. A volume of 210 pages with 53 graphs and 17 tables. Published by Harvard University Press, Cambridge, Mass., 1954. Price $4.00.

TEMPORARY UNILATERAL OCCLUSION OF THE PULMONARY ARTERY. A METHOD OF ROENTGEN EXAMINATION OF THE PULMONARY VESSELS. Acta radiologica Supplement 108. By BJÖRN NORDENSTRÖM. From the Roentgen Department (Director: Docent Bengt Holmgren), Sabbatsbergs Sjukhus, Stockholm. A monograph of 150 pages with 56 illustrations. Published by Acta radiologica, Stockholm 2, Sweden, 1954. Price Sw. Kr. 30:–.

THE CENTRAL VEINS AND DEEP DURAL SINUSES OF THE BRAIN. AN ANATOMICAL AND ANGIOGRAPHIC STUDY. Acta radiologica Supplement 107. By CURT JOHANSON. From the Roentgen Department (Director: Professor Erik Lindgren) Serafimerlasarettet, Stockholm. A monograph of 184 pages with 91 illustrations and 5 tables. Published by Acta radiologica, Stockholm 2, Sweden, 1954. Price Sw. Kr. 25:–.

RADIOLOGIE CLINIQUE DE L'INTESTIN GRÊLE DE L'ADULTE ET DE L'ENFANT. (OCCLUSION AIGUË DE L'ADULTE EXCEPTÉE.) By P. PORCHER, Membre de l'Académie de Chirurgie, Radiologiste des Hôpitaux de Paris; P. BUFFARD, Radiologiste des Hôpitaux de Lyon; J. SAUVEGRAIN, Radiologiste de Hôpitaux de Paris. A volume of 618 pages with 345 illustrations. Published by Masson & Cie, Editeurs, 120, Boulevard Saint-Germain, Paris (VI°), 1954. Price 5,000 fr.

DER HERZKATHETERISMUS BEI ANGEBORENEN UND ERWORBENEN HERZFEHLERN. By PROF. DR. OTTO BAYER, Oberarzt der I. Med. Klinik Düsseldorf; DR. FRANZ LOOGEN, Assistent der I. Med. Klinik Düsseldorf; DR. HANS HELMUT WOLTER, Assistent der I. Med. Klinik Düsseldorf. A volume of 191 pages with 131 illustrations. Published by Georg Thieme Verlag, Stuttgart, 1954. Distributors for the United States and Canada, Intercontinental Medical Book Corporation, 381 Fourth Avenue, New York, N. Y. Price $8.50.

ATLAS POSTMORTALER ANGIOGRAMME. By DR. J. SCHOENMACKERS, Apl. Professor für pathologische Anatomie, and DR. H. VIETEN, Dozent für medizinische Strahlenkunde. A volume containing 204 pages with 131 illustrations including 14 schematic sketches. Published by Georg Thieme Verlag, Stuttgart, 1954. Distributors for the United States and Canada, Intercontinental Medical Book Corporation, 381 Fourth Avenue, New York, N. Y. Price $13.55.

BASES DE L'INTERPRÉTATION RADIOLOGIQUE. RADIOGÉOMÉTRIE. By MANOEL DE ABREU, Professeur à la Faculté des Sciences Médicales de Rio de Janeiro. Published in two volumes, volume I containing 214 pages of text and volume II containing 683 illustrations. Published by Masson et Cie, Editeurs, 120, Boulevard Saint-Germain, Paris, 1954. Price 5,000 fr.

Book Reviews

THE ROENTGENOLOGIST IN COURT. By SAMUEL WRIGHT DONALDSON, M.D., F.A.C.R., Roentgenologist, St. Joseph Mercy Hospital, Ann Arbor, Mich. A volume of 348 pages. Published by Charles C Thomas, Springfield, Ill., Second edition, 1954. Price $7.75.

Dr. Samuel Donaldson's original contribution to the medicolegal aspects of radiologic practice appeared in 1937. For the second edition the text has been thoroughly revised and more than 100 pages have been added, although the general plan of the work is unchanged.

The author presents in readable form, for those not versed in legal matters, the relation which the roentgenologist bears to the laws of the land and to the courts which interpret them. A great deal of practical advice is given regarding obligations to the court and the rights and privileges of the witness. Several hundred cases are cited to illustrate how the roentgenologist may become involved, in some

fashion with the law. Decisions are quoted which reveal the many pitfalls which constantly surround the unwary practitioner.

In this period in which legal responsibilities have assumed so large a place in our daily lives and professional activities, this book is a must for the radiologist's library.

ATLAS OF EXFOLIATIVE CYTOLOGY. By GEORGE N. PAPANICOLAOU, M.D., Ph.D., Clinical Professor of Anatomy Emeritus, Cornell University Medical College. A loose-leaf volume of color plates and descriptive text. Published for the Commonwealth Fund by the Harvard University Press, Cambridge, Mass., 1954. Price $18.00.

The publication of this authoritative Atlas by Dr. Papanicolaou should be impressed upon the awareness of every reader. Exfoliative cytology as an aid in the diagnosis of cancer has reached such stature that a complete and beautifully illustrated text devoted to the structure of the cells concerned matches importance with timeliness.

The array of cellular systems which have now been studied includes not only the female genital system and the respiratory system, but the urinary system, the male genital system, and the alimentary tract as well. The increasing scope of this diagnostic method is indicated by the studies of the nonmalignant and malignant cytology of the digestive system, covering the esophagus, stomach, duodenum, gallbladder, ductal system, sigmoid colon, and rectum. In addition, studies of the exfoliative cytology of pleural, peritoneal, and pericardial exudates and of the breast are presented.

The thirty-six plates, all in color—twenty-four made up of drawings and twelve of photomicrographs—achieve a standard of excellence seldom attained by medical illustration in this country.

The double-columned text is brief but complete. The Atlas has been put together in the usable loose-leaf form for desk-top work, with an eye to the future certainty of expanding organ coverage.

The roentgenologist will be most interested in the verbal and visual explorations of the sputum, larynx, bronchi and lungs, the pelvis of the kidney, the alimentary organs listed above, and the body cavities. But quite apart from his personal interests he cannot but recognize the significant contribution made by the work as a whole.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, Robert E. Fricke, M.D., Mayo Clinic, Rochester, Minn.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago 37.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 507 Professional Bldg., Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, H. R. Morris, M.D., 1027 D St., San Bernardino.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, Oscar Harvey, M.D., 3741 Stocker St., Los Angeles 8. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, H. B. Stewart, Jr., M.D., 2920 Capitol Ave., Sacramento. Meets last Monday of each month, September to May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

RADIOLOGICAL SOCIETY OF SOUTHERN CALIFORNIA. *Secretary-Treasurer*, George Jacobson, M.D., Box 146, 1200 N. State St., Los Angeles 33.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, C. W. Bruner, M.D., 2456 Fourth Ave., San Diego 1. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, James J. McCort, M.D., Santa Clara County Hospital, San Jose-Los Gatos Road, San Jose. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Wm. W. Saunders, M.D., VA Hospital, San Francisco 21. Meets third Thursday at 7:45, Lane Hall, Stanford University Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Parker Allen, M.D., Children's Hospital, Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary-Treasurer*, William A. Goodrich, M.D., 85 Jefferson St., Hartford 14. Meets bimonthly, second Wednesday.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, John A. Long, M.D., 1801 K St., N.W., Washington 6. Meets third Wednesday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James T. Shelden, M.D., Box 1021, Lakeland. Meets in April and in October.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Richard D. Shapiro, M.D., 541 Lincoln Road, Miami Beach. Meets monthly, third Wednesday, 8:00 P.M.

NORTH FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Ivan Isaacs, M.D., 1645 San Marco Blvd., Jacksonville 7. Meets quarterly, March, June, September, and December.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 490 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta. Meets first Thursday of each month.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Philip S. Arthur, M.D., Suite 42, Young Hotel Bldg., Honolulu. Meets third Friday of each month.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 238 Hume-Mansur Bldg., Indianapolis 4. Meets twice a year, first Sunday in May and during fall meeting of State Medical Association.

TRI-STATE RADIOLOGICAL SOCIETY (Southern Indiana, Northwestern Kentucky, Southeastern Illinois). Secretary-Treasurer, Stephen N. Tager, M.D., 219 Walnut St., Evansville 9, Ind. Meets last Wednesday, October, January, March, and May, 8:00 P.M., at the Elks' Club, Evansville, Ind.

Iowa

IOWA RADIOLOGICAL SOCIETY. *Secretary*, James T. McMillan, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. M. Cherner, M.D., Hays, Kansas. Meets in the Spring with the State Medical Society and in the Winter on call.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, David Shapiro, M.D., Veterans Administration Hospital, Louisville 6. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets second Tuesday of each month.

RADIOLOGICAL SOCIETY OF LOUISIANA. *Secretary-Treasurer*, J. T. Brierre, M.D., 700 Audubon Bldg., New Orleans.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M.D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Jack Spencer, M.D., Maine General Hospital, Portland 4. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17. Meets third Tuesday, September to May.

MARYLAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Paul W. Roman, M.D., 1810 Eutaw Place, Baltimore 17.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, E. F. Lang, M.D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, John R. Hodgson, M.D., The Mayo Clinic, Rochester. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 117 N. President St., Jackson, Miss. Meets monthly, on third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, James E. McConchie, M.D., First National Bank Bldg., Independence, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Wm. B. Seaman, M.D., 510 South Kingshighway, St. Louis 10. Meets on fourth Wednesday, October to May.

Montana

MONTANA RADIOLOGICAL SOCIETY. *Secretary*, Grant P. Raitt, M.D., 413 Medical Arts Bldg., Billings. Meets annually.

Nebraska

NEBRASKA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James F. Kelly, Jr., M.D., 816 Medical Arts Bldg., Omaha. Meets third Wednesday of each month at 6 P.M. in Omaha or Lincoln.

New England

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Carye-Belle Henle, M.D., 195 N. 7th St., Newark. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, and October.

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Solomon Maranov, M.D., 1450 51st St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 9:00 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Frank Huber, M.D., 131 Fulton Ave., Hempstead, N. Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Jacob R. Fried, M.D., 1049 Park Ave., New York.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Donald H. Baxter, M.D., Albany Hospital, Albany. Meets in the capital area second Wednesday, October, November, March, and April. Annual meeting in May or June.

RADIOLOGICAL SOCIETY OF NEW YORK STATE. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo. Meets annually with the State Medical Society.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, Henry H. Forsyth, Jr., M.D., 40 Meigs St., Rochester 7. Meets at Strong Memorial Hospital, 8:15 P.M., last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maynard G. Priestman, M.D., New Rochelle Hospital, New Rochelle, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, M.D., 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, H. Milton Berg, M.D., Quain & Ramstad Clinic, Bismarck. Meets in the Spring with State Medical Association; in Fall or Winter on call.

Ohio

OHIO STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, M. M. Thompson, Jr., M.D., 316 Michigan St., Toledo.

CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Howard W. Bangs, 1381 West Sixth Ave., Columbus 12. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

CLEVELAND RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mortimer Lubert, M.D., Heights Medical Center Bldg., Cleveland Heights 6. Meets at 6:45 P.M. on fourth Monday, October to April, inclusive.

GREATER CINCINNATI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Chapin Hawley, M.D., 927 Carew Tower, Cincinnati 2. Meets first Monday of each month, September to June, at Cincinnati General Hospital.

MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, W. S. Koller, M.D., 60 Wyoming St., Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John Wayne Loomis, M.D., 919 Taylor Street Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club, Portland.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., 214 Medical-Dental Bldg., Portland 5, Ore. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, Herbert M. Stauffer, M.D., Temple University Hospital, Philadelphia 40. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Donald H. Rice, M.D., 4800 Friendship Ave., Pittsburgh 24. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at the Hotel Roosevelt.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John H. Freed, M.D., 4200 East Ninth Ave., Denver 7, Colo.

South Carolina

SOUTH CAROLINA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*. William A. Klauber, M.D., Self Memorial Hospital, Greenwood. Meets with State Medical Association in May.

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Donald J. Peik, M.D., 303 S. Minnesota Ave., Sioux Falls. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, Harvey Thompson, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, George K. Henshall, M.D., 311 Medical Arts Bldg., Chattanooga 3. Meets annually with State Medical Society in April.

Texas

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THE HEAD AND NECK

Meningiomas of the Posterior Fossa. Francesco Castellano and Giovanni Ruggiero. Acta radiol., Supplement 104, 1953.

This report is based upon 71 cases of posterior fossa meningioma observed in the Neurosurgical and Radiological Departments of the Serafimer Hospital (Stockholm). Wherever possible, the roentgenograms and surgical and autopsy specimens were restudied and the results of the re-examinations form the basis for the present discussion.

Posterior fossa meningiomas are rare; in a series of 4,185 cases of verified brain tumors (Olivecrona) they represented 1.7 per cent of all cases. They constituted 8.45 per cent of 803 meningiomas and 7.1 per cent of 954 posterior fossa tumors. Supratentorial meningiomas are four times more common than are subtentorial meningiomas.

Meningiomas are usuallly attached to the dura in the vicinity of venous sinuses or directly to the sinuses; the parasagittal and sphenoidal ridge meningiomas, with attachments close to the superior longitudinal and spheno-parietal sinuses, represent almost one-half of all intracranial meningiomas. The greater number of arachnoid cluster cells in the supratentorial dura probably accounts for the disproportion between supra- and subtentorial meningiomas.

Females constituted 69 per cent of this series, the average age on admission was about forty-three years for females and fifty-two years for males, and the average duration of symptoms was four years. All tumors were of the "global" type. Only 3 cases of "*en plaque*" meningiomas in the posterior fossa are described in the literature.

The authors classify meningiomas of the posterior fossa with respect to their dural site of attachment, dividing them into five groups:

1. Meningiomas of the cerebellar convexity.
2. Meningiomas of the tentorium.
3. Meningiomas of the posterior surface of the petrous bone.
4. Meningiomas of the clivus.
5. Meningiomas of the foramen magnum.

Each group is discussed in turn. In addition, the authors discuss the very rare meningiomas combined with neurinomas, multiple meningiomas, and meningiomas without dural attachment. A chapter is also devoted to meningiomas of Meckel's cavity extending into the posterior fossa.

Each chapter includes an historical introduction and sections on pathology, incidence, sex, age, symptomatology, objective findings, radiology, surgical notes, and summary and conclusions. This abstract is for the most part confined to the radiological aspects. The reader is referred to the original paper for a comprehensive picture of the diagnostic problems, the physical findings, the surgical difficulties, etc.

Meningiomas of the cerebellar convexity are rare, representing 9.8 per cent of the present series. The signs of intracranial hypertension are "constant, early and preeminent." In all cases of the series (7) the roentgenographic findings warranted the diagnosis of a space-occupying lesion in the posterior part of the posterior fossa. Most showed sellar signs of intracranial hypertension. Ventriculography invariably revealed hydrocephalus of the lateral ventricles and forward displacement of the aqueduct. Other signs sometimes found included elevation of the posterior portion of the third ventricle, upward displacement of the posterior part of the ipsilateral ventricle, kinking of the aqueduct, and contralateral fourth ventricle displacement.

In the differential diagnosis, tentorial meningiomas with posterior sites of attachment and intracerebellar tumors must be considered. In the tentorial meningiomas the aqueduct kinking is usually pronounced and fourth ventricle filling is seldom obtained. At the age typical of meningioma, the intracerebellar tumors are almost exclusively angioreticulomas. In these tumors there is usually marked upward displacement of the posterior part of the third ventricle and frequent dilatation of the fourth ventricle.

Meningiomas of the Tentorium: There are 3 different types of tentorial meningiomas: the infratentorial meningiomas are confined to the under surface of the tentorium; the supratentorial meningiomas grow on its upper surface; the perforating meningiomas grow both above and below the tentorium. The supratentorial tumors are not posterior fossa tumors and therefore are not included in this study.

Tentorial tumors generally have a large site of attachment but are always of the "global" (Cushing) rather than the *en plaque* type. The most common site is the posterior portion of the tentorium, close to the transverse sinus and to the *confluens sinuum*. A less frequent but important site is at the junction of the free margin of the tentorium with that of the falx (CFT). This zone is mobile and may be displaced downward by a supratentorial tumor or upward by an infratentorial one.

Because of poor vascularization of the tentorium, the tentorial meningiomas are not as a rule highly vascularized. The tumors frequently invade one of the transverse sinuses, the straight sinus, or the confluens sinuum. They exert considerable force on the cerebellum, pressing it downward and forward, causing encroachment upon the aqueduct, almost invariably resulting in complete stenosis.

Radiographic signs of increased intracranial pressure were present in 12 out of 15 cases and invariably consisted of changes in the region of the sella only. Tumor calcifications were present in 2 cases, but the authors do not think it possible, from a roentgenologic standpoint, to speak of calcification typical of meningiomas.

In all cases ventriculography revealed more or less marked dilatation of the lateral and third ventricles. The hydrocephalus appeared to be greater in tumors with an anterior site of attachment. In cases of perforating meningiomas, the hydrocephalus was often asymmetrical, the left ventricle usually being the larger, irrespective of the side of the tumor. Since even in normal cases the left ventricle is the larger, this finding may only represent exaggeration of the physiological asymmetry. Four cases showed contralateral displacement of the septum pellucidum and third ventricle. In 5 cases there were alterations of the posterior parts of the ventricles, including impression from below, flattening and forward displacement, and compression from behind. Not all of these changes were present in each case. In all cases there was upward displacement

of the posterior part of the third ventricle. The degree of filling of the aqueduct and fourth ventricle ranged from non-filling to complete filling, with no evident relation to the site and type of tumor. In no instance was the fourth ventricle dilated, though it was displaced toward the contralateral side. The aqueduct was displaced forward in all cases, and in all but 2 it was deformed, either kinked or straightened. When the aqueduct was straightened, the tumor was in the vicinity of the CFT causing direct pressure on the brain stem.

Carotid arteriography was performed in 3 cases. In 2 it merely disclosed hydrocephalus; in the third it confirmed the presence of a space-occupying occipital lesion. In 1 case vertebral angiography was performed, confirming the encephalographic diagnosis of a space-occupying lesion in the right part of the posterior fossa.

In cases of CFT meningioma it is possible to make the exact diagnosis of the site and nature of the lesion. The characteristic ventriculographic picture consists of hydrocephalus, straightening of the aqueduct, dilatation of the superior portion of the aqueduct with constriction of its inferior portion, and non-filling of the fourth ventricle. In the differential diagnosis, glioma of the vermis can be excluded, since it is characterized by marked aqueduct kinking; pinealomas present a filling defect in the posterior part of the third ventricle; tumors of the corpora quadrigemina cause characteristic basal displacement of the aqueduct, usually with no deformity of the posterior part of the third ventricle.

With the exception of CFT tumors, the ventriculographic picture of infratentorial meningiomas and cerebellar tumors is fundamentally the same: hydrocephalus, upward displacement of the posterior portion of the third ventricle, and kinking of the aqueduct. However, in cerebellar tumors there is generally good visualization of the whole infratentorial portion of the ventricular system, whereas the contrary is frequently true of tentorial tumors.

Meningiomas of the Posterior Surface of the Petrous Bone: The posterior surface of the petrous bone is the most frequent site of attachment of posterior fossa meningiomas: 42 per cent of cases in this series. All but 1 of the tumors were of the global type, varying from the size of a hazelnut to that of an egg.

Most of the patients in the present series underwent operation with a mistaken diagnosis of acoustic neurinoma or a diagnosis merely of a space-occupying lesion in the cerebellopontine angle. Roentgenologic studies were only rarely satisfactory and the material for review is limited to 17 roentgen examinations of the skull and 4 ventriculograms. Skull roentgenograms were negative in 6 cases, and evidence of intracranial hypertension was observed in 7. This generally consisted of slight sellar erosion or decalcification. Seven cases showed posterior fossa changes, including intratumoral calcification, bone destruction, and structural changes in the petrous bone. In 1 case there was sharp amputation of the apex of the petrous bone, an example of a meningioma simulating an acoustic tumor. The authors note that the petrous bones are frequently asymmetrical, making it difficult to be certain of minor pathological changes.

Each of the 4 ventriculographic studies showed hydrocephalus and upward displacement of the posterior part of the third ventricle, which in 2 cases was also displaced contralaterally. An exact diagnosis of the tumor site is impossible.

Meningioma of the posterior surface of the petrous bone may simulate disseminated sclerosis, and all patients with symptoms of the latter condition should have a complete roentgenologic study. Meningiomas in this region may also be a cause of trigeminal neuralgia.

Clivus Meningiomas: In these very rare meningiomas there is generally a lack of signs of intracranial hypertension in skull roentgenograms. This is because hydrocephalus is usually not of high degree and because the third ventricle may be flattened from below by the tumor transmitting pressure through the brain stem, so that the infundibular recess does not come in contact with the dorsum sellae.

Vertebral arteriography and lumbar encephalography are useful in the diagnosis. Classically the roentgenographic findings are as follows: backward displacement of the superior part of the cisterna pontis; upward and backward displacement of the cisterna interpeduncularis; no marked lateral displacement of the aqueduct and fourth ventricle; poor visualization of the cisternae ambiens and pontocerebellaris on the side to which the tumor is expanding; lateral and backward displacement of the basilar artery; and abnormal vascularity in the region of the clivus.

Meningiomas of the Cavum Mecklii Extending into the Posterior Fossa: Though meningiomas of the cavum Mecklii arise in the middle fossa, they often invade the posterior fossa. The radiological aspects of the infratentorial portion of the tumor may simulate meningioma of the posterior surface of the petrous bone or of the clivus. A distinguishing feature of meningiomas of the gasserian region as opposed to neurinomas is the lack of bony destruction.

Meningiomas of the Foramen Magnum: In this group the authors include only those meningiomas attached to the dura covering the rim of the foramen magnum. All but 1 of 24 cases studied (including 21 from the literature) showed clinical signs of a spinal lesion, and in only 1 case were signs of an intracranial lesion absent. Direct skull examination was performed in 9 cases. It was negative in 5 cases, showed sellar signs of intracranial hypertension in 3 and questionable asymmetry of the foramen magnum in 1. Oil myelography is dangerous and practically useless in cases of this type. False findings were revealed in a number of cases and at least one death is attributed to the procedure. Encephalograms were obtained in 2 cases. One was normal; the second showed flattening of the cisterna pontis, indicating a space-occupying lesion in the posterior fossa. The authors caution that encephalography is best performed in these cases by injecting a few cubic centimeters of air before fluid is withdrawn. If roentgenograms show the inferior pole of the growth outlined by air, the examination should be discontinued without attempting to fill the ventricular system. Ventriculography was performed in 4 cases. One showed upward displacement of the posterior portion of the third ventricle and contralateral aqueduct displacement. The others showed moderate hydrocephalus and lateral or backward displacement of the aqueduct and fourth ventricle. Ventriculography is the examination of choice, though a case has been reported in which this procedure was followed by death due to bulbar failure.

Combined Meningiomas and Neurinomas; Multiple Meningiomas: A single acoustic neurinoma, bilateral acoustic neurinomas, multiple intracranial neurinomas, or a generalized neurofibromatosis may be accompanied

by one or more meningiomas. The combined tumors seem to have a familial and hereditary character. In these combinations of tumors one or more meningiomas may be located in the posterior fossa. The authors report 1 case with 2 meningiomas in the posterior fossa. The diagnosis of multiple tumors is notoriously difficult, since each tumor may contribute a defect or displacement in the ventriculogram.

Meningiomas Without Dural Attachment: A few cases of meningioma without dural attachment have been reported. These are divided into tumors which arise from the choroid plexus proper and grow exclusively intraventricularly and those arising from the choroidal telae, growing in part intraventricularly and in part intraparenchymatously. The authors report a case of meningioma growing partly in the left cerebellar hemisphere, having no dural attachment.

This monograph is profusely illustrated with ventriculograms and explanatory line drawings, skull films, arteriograms, and gross and microscopic tumor specimens. It is highly recommended as a stimulus to all who are interested in neuroradiology. The authors seem to be able to "milk dry" every minute detail in the air studies. Especially stimulating is the information they derive from minor changes in the basal cisterns. Yet they humbly note that they are "positive that the radiological possibilities in the diagnosis of brain tumors are still far from being completely explored."

One hundred and twenty-nine illustrations.

BERTRAM LEVIN, M.D.
Chicago, Ill.

Pneumocisternography of the Posterior Fossa. Preliminary Report of a New Technique. A. Morello. J. Neurosurg. **10:** 552–554, September 1953.

A new technic for visualization of the ventricular and cisternal cavities of the posterior fossa following injection of air into the lumbar subarachnoid space is described. The main feature of this method is the fact that the gas-fluid exchange is done with the patient in the horizontal position (with the head of the table tilted down 5°); hence the gas does not reach the intracranial cavity while it is being injected, making the procedure safer and less disturbing, particularly in cases of increased intracranial pressure. The gas collects in the lower lumbar subarachnoid space and then ascends to the region of the foramen magnum, with the quantity, speed, and direction fully controlled by tilting the radiological table on which the patient is lying. The report discusses merely technical aspects of the procedure without touching upon the indications, results, or comparative advantages.

Four roentgenograms; drawings illustrating the technic. HARRIET M. WISNIEWSKI, M.D.
Cleveland City Hospital

Angiographic Changes in Sudden and Severe Herniation of Brain Stem through Tentorial Incisure. Report of Five Cases. John Riishede and Sven Ethelberg. Arch. Neurol. & Psychiat. **70:** 399–409, September 1953.

In 5 different cases angiography was performed at a time when increased intracranial pressure had already produced severe herniation of the brain stem downward. In each one the contrast medium was held in the internal carotid artery even though at autopsy no obliteration of the lumen was found. There was no reason to believe that compression or spasm could have caused the blockage in any instance.

The authors believe that the phenomenon was due simply to a reflex diminution in cerebral blood flow initiated by the anatomical changes in the centers in the brain stem. The increased intracranial pressure itself may also be a factor when it approaches the arterial pressure level. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Cerebral Arterio-venous Anomaly. J. S. Coller, M. B. M. Denny, and B. N. Frazer. South African M. J. **27:** 790–795, Sept. 12, 1953.

A single case is reported with angiographic demonstration of an extensive arteriovenous aneurysm in the posterior parietal region, supplied mainly by the middle cerebral group but with some branches from the anterior and posterior cerebral vessels and probably also from the middle meningeal, although this was not proved.

Surgery was contraindicated by the extent of the lesion and because the patient's mental status was so poor that little benefit could be expected. He had been having epileptic fits for ten years, with gradual deterioration. X-ray therapy is not considered of value in cases of this type, and tying of the carotid artery is dangerous.

Eight roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Prostatic Metastases Simulating Intracranial Meningioma. A Case Report. J. Paul Schaerer and Robert L. Whitney. J. Neurosurg. **10:** 546–549, September 1953.

The authors report a case which illustrates an unusual manifestation of carcinoma of the prostate, with radiological findings almost pathognomonic of meningioma *en plaque*. The patient was a seventy-one-year-old white man whose chief complaints were protrusion of the right eye and numbness in that area.

Considerable hyperostosis was noted in the entire sphenoid wing, the zygomaticotemporal process, and a relatively large portion of the floor of the middle fossa. There was associated severe exophthalmos with loss of visual acuity on the involved side. In order to prevent further loss of vision, decompression of the optic nerve was undertaken, and biopsy specimens were obtained, which showed anaplastic carcinoma, apparently metastatic. Areas of increased density in the bones, demonstrated roentgenologically, were characteristic of osteoblastic metastases of prostatic cancer. Carcinoma of the prostate was also indicated by rectal examination, which disclosed a hard nodule in the right lobe of the gland. The diagnosis was confirmed at autopsy.

The authors mention several important features which should have aided in establishing the correct diagnosis: the rapidity of visual loss, sudden onset of exophthalmos, the patient's age (71) and sex, and the hyperostotic involvement of the zygomaticotemporal process. Meningioma *en plaque* ordinarily occurs in females, in the fourth decade, and is characterized by gradual loss of vision, gradual development of exophthalmos, and distinctive hyperostotic bone changes.

Three roentgenograms; 1 photograph.

HARRIET M. WISNIEWSKI, M.D.
Cleveland City Hospital

Experimental Use of a Preparation of Ethyl Diiodostearate as a Contrast Medium for Diagnostic Cerebral Angiography. Henry W. Dodge, Jr., Alfred Uihlein, and John H. Grindlay. J. Neurosurg. **10**: 453–456, September 1953.

An experimental study was carried out on 15 dogs and 5 cats with Angiopac (an ionized aqueous emulsion of diiodostearate) as a contrast medium for cerebral angiography, with special attention to radiopacity, toxicity, irritant effect in tissues where it might be injected inadvertently, and elimination from the body. The technic of the procedure simulated that used in human carotid angiography as closely as possible. Doses of 0.5 to 10.0 c.c. per injection were used, with no animal receiving more than 20 c.c. in any series of repeated injections.

Dogs consistently tolerated only doses of 3 c.c. or less, larger injections (8 to 10 c.c.) causing critical symptoms or death. Three dogs died as a direct result of the injection of Angiopac into the carotid system. Death was usually due to respiratory failure. Two dogs required artificial respiration and termination of the procedure. No cats died as a result of the injections. Radiographic contrast was superior to that obtained with Diodrast, particularly in showing details of smaller vessels, but equal amounts of Diodrast did not produce similar reactions.

Intentional intramuscular injections in two dogs caused swelling, erythema, and tenderness to palpation at the injection site, with microscopic evidence of intense polymorphonuclear infiltration. There was radiographic evidence of retained medium in the tissues three months after intramuscular injection. Roentgenograms of heads and bodies and histologic examination of kidneys, brain, and liver one to two days after intracarotid injections showed no evidence of damage or residual Angiopac.

It has been suggested that the unusual response of dogs to Angiopac injection and lack of effect on cats may be due to an allergic response to the solvent used in the manufacture of the medium.

In view of these studies, and the knowledge that such reactions may occur in man, the authors believe that the incidence of unfavorable effects may be greater than with 35 per cent Diodrast, and they therefore hesitate to use Angiopac clinically.

Four roentgenograms; 1 photomicrograph; 1 graph.

HARRIET M. WISNIEWSKI, M.D.
Cleveland City Hospital

Experimental Studies on the Circulation of the Cerebrospinal Fluid and Methods of Producing Communicating Hydrocephalus in the Dog. Peter H. Schurr, Robert L. McLaurin, and Franc D. Ingraham. J. Neurosurg. **10**: 515–525, September 1953.

The authors have attempted to discover any possible differences in the cerebrospinal fluid flow and absorption in the dog, the cat, and the Rhesus monkey, so that comparisons that have been made between these circulations and that of man might be evaluated. Secondarily, an attempt was made to find a satisfactory preparation for the study of communicating hydrocephalus in animals. The studies were made for the most part with Pantopaque. In one cat and one monkey the experiments were repeated with the less viscous Thorotrast, but the results did not differ materially.

Significant differences in the cerebrospinal fluid circulation in these three species were demonstrated, and there is reason to believe that similar differences may exist between the circulation of the dog and of man. Care must be exercised, therefore, in basing conclusions as to the cerebrospinal fluid circulation in man upon evidence from the lower animals. Though an inflammatory reaction was observed following Pantopaque injection, this was not felt to contraindicate the use of that medium in myelography, since in the experiment a greater amount was employed relative to the total spinal fluid volume than is used clinically. However, it was thought that as much Pantopaque as possible should be removed, since it caused subarachnoid fibrosis in dogs.

Several methods of producing experimental communicating hydrocephalus in the dog are described. The most satisfactory is interpeduncular injection of kaolin suspension followed by cisternal injection of Pantopaque.

Seven roentgenograms; 2 photomicrographs; 3 photographs.

HARRIET M. WISNIEWSKI, M.D.
Cleveland City Hospital

Transcranial Removal of Intraorbital Tumors. J. Grafton Love and Henry W. Dodge, Jr. Arch. Surg. **67**: 370–379, September 1953.

During a recent eight-year period 73 intraorbital tumors were removed transcranially at the Mayo Clinic. Forty-four of these produced x-ray changes, such as (1) soft-tissue density in the orbit; (2) erosion of bone of the orbit, optical canal or superior orbital fissure; (3) thickening of bone about the orbit; (4) phleboliths or other calcification in the orbit. Routine views of the skull and optic canals sufficed in the large majority of cases. Occasionally tomography, contrast orbitography, carotid angiography, or encephalography was helpful for complete evaluation.

Indications listed by the authors for transcranial approach to the orbits are: (1) deeply situated neoplasms; (2) suspicion or evidence of cranio-orbital or orbitocranial extension; (3) evidence of a highly vascularized tumor; (4) field and nerve-head changes indicative of early encroachment on the optic nerve.

Advantages of the transcranial approach include: (1) excellent visualization of the orbital contents and extent of the lesion; (2) more adequate control of hemorrhage; (3) added decompression of orbital contents; (4) opportunity for exploration of nearby intracranial structures; (5) simultaneous removal of bilateral tumors; (6) opportunity for total removal of benign or low-grade malignant tumors. Early removal of benign tumors produced very gratifying results. When there was severe involvement, the patients seemed to have fewer postoperative disabilities than might have been expected from other approaches.

Eight figures.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Generalized Salivary Gland Virus Infection. Report of a Case of Its Occurrence in an Adult. G. Amromin. Arch. Path. **56**: 323–327, September 1953.

Disseminated cytomegalic inclusion disease has been reported in infants not infrequently. However, in the adult, dissemination of the submaxillary gland virus is unusual.

The author's patient was a 64-year-old white male apparently in good health until one month before hospitalization, at which time he experienced an episode of

"flu," characterized by fever and cough. After several days without therapy he apparently recovered. There were recurrent episodes, however, of cough and fever, with the temperature reaching as high as 103° F. Since the onset of the illness there had been a weight loss of 30 to 35 pounds. A persistent pain, exaggerated on inspiration, near the left sternal border appeared twenty-four hours before admission to the hospital. Upon admission the cough was productive of a thick, tenacious sputum. There had been no hemoptysis. The productive cough and chest pain continued and on the fifth hospital day the sputum became rust-colored and remained so until death on the eighteenth hospital day. The total duration of the illness was approximately forty-eight days.

A roentgenogram of the chest on the day of admission revealed some elevation of the right diaphragm, displacement of the heart and mediastinum to the right, and a dense area of infiltration just to the right of the hilus on that side. Many coarse bronchovascular markings radiated from this area. Overlapping it and partially overlying the cardiac silhouette was a 5-cm. area of radiolucency. The left hilus was enlarged and merged into a soft mottled infiltration extending toward the base. Four days later there was evidence of more widespread involvement bilaterally.

At autopsy, in addition to an abscess in the medial portion of the upper lobe of the left lung and several nodules in the left lower lobe, there were numerous areas of infiltration closely resembling infarcts.

On microscopic study, scattered areas of necrosis were found throughout the lungs characterized by complete loss of lung architecture. In places many large cells were free in the alveolar spaces and these cells frequently contained oval inclusion bodies. Many areas which grossly resembled pulmonary infarcts consisted of necrosis and organizing pneumonia, with large numbers of giant cells with inclusion bodies.

In addition there was extensive necrosis of the adrenal medulla bilaterally and the zona reticularis and inner portions of the zona fasciculata. Scattered cortical cells adjacent to areas of necrosis contained inclusions similar to those in the lungs. While the patient died with generalized salivary gland virus infection predominantly involving the lungs and adrenals, the inclusions were found in greatest profusion intimately associated with areas of organizing pneumonia and pulmonary necrosis. It was felt that the extensive bilateral adrenal necrosis was the immediate cause of death.

This is the sixth adult case in the literature.

Two roentgenograms; 2 photomicrographs.

RICHARD E. OTTOMAN, M.D.
Los Angeles, Calif.

Differential Diagnosis of Salivary Calculi and Phleboliths in the Cheek. Klaus Pfeiffer and Konrad Seige. Radiol. clin. **22:** 445–461, September 1953. (In German)

The authors report the case of an 18-year-old patient who complained of swelling of the right cheek since childhood. A diagnosis of salivary calculi of the right parotid gland had been made and he was referred for irradiation to produce a suppression of secretion. A preliminary examination, described in great detail, failed to confirm the diagnosis. Films taken in various projections revealed 12 calcific shadows located near the angle of the jaw on the right and extending upward. They ranged in size from a millet seed to a pea, the larger ones showing central areas of radiolucency. Sialography disclosed no abnormal findings on the left, and on the right the ducts were not obstructed by the calcified concrements.

Salivary calculi are encountered mainly in males (4 to 1), occurring in the submaxillary glands (75–82 per cent), in the parotid gland (13–20 per cent) and in the sublingual gland (5 per cent). They may produce an obstruction to the flow of saliva, with subsequent swelling. The roentgen pattern depends on the calcium content. Some 15 to 20 per cent of such calculi are not sufficiently radiopaque to be demonstrated roentgenographically.

In the case described here, the differential diagnosis lay between phleboliths in an intramural hemangioma and salivary calculi. Sialography disclosed that the stones were not connected with the ducts, and the roentgen picture was compatible with phleboliths rather than laminated stones. On the basis of these observations and clinical studies, it was decided that the case was one of intramural hemangioma of the cheek, with phlebolith formation, and treatment by means of radium implantation was instituted.

Seven roentgenograms; 3 photographs; 4 tables.

JULIAN O. SALIK, M.D.
Baltimore, Md.

THE CHEST

Removal of Radio Opaque Foreign Bodies from the Bronchi Utilizing the Stereoscopic Fluoroscope. Alden H. Miller. Ann. Otol., Rhin. & Laryng. **62:** 869–877, September 1953.

This is a further report on the use of the stereoscopic fluoroscope in the removal of foreign bodies from the bronchi. The procedure was originally described in 1951 (Arch. Otolaryng. **53:** 68, 1951. Abst. in Radiology **57:** 774, 1951).

The stereofluoroscope produces images having three dimensions. It uses two tubes which operate on opposite halves of the cycle of the alternating current. These tubes are spaced so that their positions correspond respectively with the two different positions successively occupied by a single tube in making a stereoscopic pair of radiographs, and their fluoroscopic images have the same relationship to each other as do the two radiographs of the stereoscopic pair. Although both images appear on the same screen, they are produced alternately because of the alternating current, instead of simultaneously. An optical device causes the right eye to see the images cast by the left tube, and the left eye to see the images formed by the right tube. The apertures open and close alternately, in synchronism with the operation of the tubes. The observer is not conscious of this, and each eye appears to be seeing continuously.

Since each tube is on only half the time, the two tubes do not produce any more radiation than one tube on a fully rectified machine using both halves of the alternating circuit. The filtration is 2 mm. of aluminum. The radiation received by the patient and the secondary radiation received by the operating personnel is thus substantially the same as with use of the conventional instrument.

It is estimated that a child receives 7.1 r per minute to the skin with a 10 milliampere setting, 60 kv.p., and 30 inches screen-target distance, and that the average adult receives 8.3 r per minute at 65-kv.p.

Thirteen procedures were done on 8 patients with stereofluoroscopic guidance, and the removal of the foreign body was successful in all but one. In the 7 successful procedures, the patients received, respectively, 31, 8, 25, 12, 11.5, 62.2, and 110 r to the skin. An erythema developed in 1 patient who received 300 r in an unsuccessful attempt to remove a straight pin.

Assuming use or control by trained personnel, versed in the dangers of radiation, this machine should have some very obvious advantages. Only a few machines are in clinical use at the present time, and it is to be noted that one of the discussants complained that his could not be made to work properly.

Seven roentgenograms; 2 photographs.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Artificial Pneumomediastinum. M. Bariéty and Ch. Coury. J. franç. méd. et chir. thorac. **7**: 557–598, 1953. (In French)

This is an extensive appraisal of the procedure of artificial pneumomediastinum. Historical data, methods of introducing the gaseous contrast medium, and various other technical factors are considered. The radiologic technic, anatomic considerations, and some possible diagnostic findings are discussed. The method is said to be of value in defining more clearly tumors of the mediastinum, revealing certain changes of the cardiovascular system, and even in demonstrating some hilar tumors. Possible therapeutic uses of artificial pneumomediastinum are also mentioned. These include reduction of mediastinal hernias, extrapleural mediastinal collapse therapy, treatment of hemoptysis, and occasionally the prevention of pericardial symphysis.

Nine roentgenograms. CHARLES NICE, M.D.
University of Minnesota

Pulmonary Distention as Seen in the Lordotic Roentgenogram. Joseph Gordon and W. Berkeley Zinn. J. Thoracic Surg. **26**: 261–274, September 1953.

A lordotic roentgenogram indicates the point of apposition of the two lungs in the anterior mediastinum as a plainly visible linear radiopacity. This line is apparently due to the four layers of pleura (two parietal and two visceral) in close proximity to one another between air-containing lung on either side. By reference to this linear radiopacity, pulmonary herniation in the anterior mediastinum can be identified readily before the heart and trachea are shifted. When the latter structures are deviated, unilateral distention of lung is obvious.

The authors define anterior mediastinal lung hernia as existing when the anterior portion of one lung extends beyond the trachea into the opposite hemithorax. Under these circumstances, one lung, or a portion of it, will be distended to an unusual degree. A lordotic roentgenogram will frequently reveal such a localized area of distention, though it may not be appreciated on conventional films.

This view has proved of particular value in studying varying degrees of loss of lung volume and consequent herniation of the opposite lung in various parenchymal and bronchial diseases, following resection of lung tissue, and in cases of adhesive pleuritis with limitation of expansion. Lordotic films have also been useful in studying the chest routinely following thoracoplasty. It is felt that the demonstration of the increased pulmonary distention helps explain why further loss of pulmonary function sometimes occurs after this surgical procedure. In addition, the authors use this view for checking on the re-expansion of pneumothorax and as a postoperative follow-up in pulmonary resections of a lobe or less. They feel that it aids in determining whether or not a space-reducing thoracoplasty will be necessary.

Thirteen cases are illustrated by 42 roentgenograms.

RICHARD E. OTTOMAN M.D.
University of California

Tomography in Collapse Therapy of the Lungs. Felipe Aladro Azueta, Xavier Hernandez S., and Frumencio Medina. Rev. mex. de radiol. **7**: 266–270, May-June 1953. (In Spanish)

Tomography is necessary when pulmonary cavities are suspected because of positive bacteriologic findings, since such cavities may be masked by so-called coin lesions and exudative infiltration, or may be obscured by the ribs, especially in pneumoperitoneum therapy. Unsuspected cavities on the apparently normal contralateral side may also be revealed by this means.

Tomography may prove to be of great help in intrapleural and extrapleural pneumothorax, extrapleural oleothorax, thoracoplasty, phrenic crush, and collapse therapy with Lucite balls. Numerous cases are cited and 36 roentgenograms illustrate the advantage of the procedure.

E. KRAFT, M.D.
Newington, Conn.

Radiologic and Bronchoscopic Observations on Diffuse Narrowing of the Lumen of the Tracheobronchial Tree. Roy R. Greening and Joseph P. Atkins. Ann. Otol., Rhin. & Laryng. **62**: 828–836, September 1953.

Because bronchographic findings are so frequently reported as normal in patients with clinical evidence of pulmonary disease, the authors made an exhaustive review of such bronchograms and found that a large number showed a consistent abrupt narrowing of the bronchi shortly after their origin from the main trunks. This they have chosen to call "bronchial attenuation." Patients displaying this finding are divided into three clinical groups: (1) those with diffuse pulmonary emphysema, (2) those with asthma or asthmatic bronchitis and hypersensitivity states, and (3) a less easily defined group presenting clinical features strongly suggestive of bronchiectasis. The present report deals with the last group.

The patients are young adults with long-standing pulmonary symptoms and productive cough with sputum possessing no identifying characteristics. There is usually a history of repeated bouts of pneumonia-like episodes and a tendency to lose weight. Clinical examination reveals a wheezing type of respiration with a variety of râles. The auscultatory findings have been confused with those heard in patients with bronchiectasis. These clinical findings being nonspecific, the original diagnostic impressions included bronchogenic carcinoma, tuberculosis, bronchiectasis, chronic lung abscess, and chronic bronchitis. On bronchoscopy, these patients showed little disturbance in the expulsive force of the cough, consistent mucosal hyperemia, less secretion than one would expect in view of the physical findings, and no expiratory intrusion of the posterior bronchial wall.

Conventional roentgenograms of the chest show

nothing distinctive and are usually thought to be normal. The notable findings, demonstrated by bronchography, are the anatomic narrowing of the bronchi shortly after their emergence from the main bronchial trunk and wide spacing of these bronchi in the pulmonary pattern. The size of the bronchial lumen differs in different pulmonary segments and may even vary from time to time in the same segment of the lung. During bronchography, there are difficulty and delay in bronchial filling, with prolonged retention of the contrast substance in the smaller bronchi of the affected segments. This results in almost no aveolar filling.

It is not known whether bronchial attenuation is a physiologic alteration or an anatomic abnormality, although the authors incline toward the former explanation. It is present in asthma and seems to be an essential component of emphysema. In patients who are suspected of having bronchiectasis, but in whom the bronchoscopic findings are not confirmatory, this phenomenon may be striking. Four case histories are presented.

Five roentgenograms.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

The Diagnosis and Management of Solitary Circumscribed Lesions of the Lungs. Corrin H. Hodgson and John R. McDonald. Dis. of Chest **24**: 289–303, September 1953.

The lowering of mortality and morbidity in thoracotomy has led to the increasing use of exploration as an aid to diagnosis of solitary circumscribed or coin lesions in the lungs. In most cases the diagnostic limitations are such as to prevent making a diagnosis except after surgical removal of tissue. Nevertheless, careful individual consideration must be given, since not all patients should be subjected to thoracotomy.

Many factors contribute to the difficulty of diagnosis: the frequent peripheral location (beyond the limits of bronchoscopy) of the lesion; the long delay in obtaining reliable results from cultures of sputum; the necessity of haste if the condition be malignant; the low percentage (10–15 per cent) of malignant cases in which cells can be demonstrated in the sputum; the limited value of skin sensitivity tests in indicating pathogenic organisms in granulomata, and the very few reliable distinguishing roentgenographic characteristics of the different lesions. Skin tumors and moles, the nipple shadow, tumors of the thoracic wall, and certain pleural lesions (plaques, encapsulated fluid, fibrous mesothelioma) may simulate intrapulmonary masses.

Non-neoplastic intrapulmonary lesions which cause circumscribed shadows include vascular abnormalities, pneumonitis, abscess, infarction, and hydatid disease, as well as the various granulomata. Microscopic study of granulomatous tissues is inconclusive for differentiation; complete bacteriologic study is essential.

In the field of neoplasms, benign tumors such as bronchogenic cysts and hamartoma must be considered. Calcification may be present in a hamartoma, making it indistinguishable from a calcifying granuloma. Adenoma of the bronchus will produce metastases in 5 to 10 per cent of cases. Most adenomas are within the range of the bronchoscope.

Haste in management of solitary lesions is necessitated because of the possibility of malignancy. A solitary metastatic lesion cannot always be identified as secondary even after microscopic study, nor is the knowledge of a primary tumor outside of the lungs a sure indication that the pulmonary lesion is metastatic. Exploration may still be justified either because the lung lesion may prove not to be metastatic or because the removal of the metastasis may provide worth-while palliation.

Most pulmonary nodules containing calcium do not require surgical removal, but clinical judgment must be the determining factor in the individual case. Rarely is calcium present in a carcinoma. Some granulomata with calcium still yield positive cultures and are capable of spreading infection; this would be reason for removal. The laminated lesions, however, are sterile.

Twenty-four roentgenograms; 2 photographs.

D. DEF. BAUER, M.D.
Coos Bay, Ore.

Bronchogenic Carcinoma. A Review Illustrated by 100 Cases. David Adler and Denis Fuller. South African M. J. **27**: 841–846, Sept. 26; 874–879, Oct. 3, 1953.

Carcinoma of the lung is the most common malignant visceral tumor in males. Adler and Fuller here analyze their first 100 consecutive cases and review the literature relating to incidence and etiology.

Grossly, there are four pathologic types: (1) peripheral, (2) central hilar, (3) central mediastinal, and (4) Pancoast's tumor. The pathological complications depend upon extension of the growth by continuity or contiguity, lymphatic permeation, hematogenous spread and secondary infection. Histologically, there are three types (Ochsner *et al.*: J. Thoracic Surg. **17**: 573, 1948): (1) epidermoid (2) adenocarcinoma, and (3) undifferentiated (with small round cells, large clear cells, or irregular cells).

The most important factor in making the diagnosis is to think of the possible existence of the disease. One of the gravest errors is to think the patient should look as though he has a carcinoma or to be misled by a patient who does not look as if he harbors disease when the roentgen findings are consistent with neoplasm.

Early symptoms of bronchogenic carcinoma are slight. They include alteration in a chronic cough, slight hemoptysis, and unilateral wheezing. Later signs and symptoms are pleuritic pain, huskiness of the voice due to left recurrent laryngeal involvement, hiccough, swelling of the face due to superior vena caval obstruction, and dysphagia from pressure of enlarged lymph nodes. At times the symptoms may be chiefly those of suppuration.

A radiological investigation should be made in the presence of a fresh cough or change in the character of a cough. Carcinoma of the lung can at some time or other mimic, radiologically, almost every other condition in the chest. X-ray studies may show the growth as a well defined peripheral mass, as an indistinct hilar thickening, or as mediastinal widening. There may be signs of pneumonia, segmental atelectasis, or localized obstructive emphysema.

In the authors' experience, good tomography is a valuable aid in demonstrating complete or partial bronchial occlusion. A barium-swallow study should be done to check lymph node enlargement. The treatment of choice is surgical extirpation, either by pneumonectomy or lobectomy.

Radiation therapy has a definite place in carcinoma of the lung and often diminishes tumor size, relieves bronchial obstruction, and reduces pain. The authors

have used radium needles intrabronchially to ameliorate obstruction.

Survival figures are cited from various sources, and it is stated that the gross survival rate for all cases is 7.7 per cent (Ochsner). The operative mortality is placed at less than 10 per cent.

Weinbren in his comment questions the figures quoted by Adler and Fuller as too favorable. Furthermore, he believes that they do not supply all the pertinent information. He adds that the proportion of cases of bronchogenic carcinoma resected after exploration is 56 per cent, though only 15.2 per cent are suitable for exploration.

Weinbren is concerned with the effect of exploration without resection on the survival of patients, and also the fate of those not explored as compared to the survival rate after radiotherapy or surgery, surgery followed by radiation, or radiation followed by surgery. Buchberg *et al.* are quoted as reviewing 7,815 cases from the leading centers of America and England (Dis. of Chest **20:** 257, 1951). The absolute five-year survival of this group was less than 1 per cent.

As to treatment, Weinbren decries the implantation of radium through the bronchoscope. He has found radon implantation, on the other hand, useful in suitable cases, and has employed this procedure for the past three years. It may be supplemented by deep x-ray therapy. Palliative x-ray therapy he regards as just as useful as palliative surgery. Postoperative irradiation apparently has no influence on the survival rate, and there are not sufficient statistics available for analysis of the results of preoperative irradiation.

The difficulty under present conditions is to establish which cases are really operable. It would appear that too many inoperable cases are explored.

Fourteen roentgenograms; 9 tables.

M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Congenital Lung Cysts in Infants. Harold M. Albert and Willis J. Potts. Pediatrics **12:** 283–287, September 1953.

The authors discuss congenital lung cysts in general briefly, and the symptoms, diagnosis, and treatment of rapidly expanding congenital lung cysts at length. These more severe lesions enlarge rapidly, embarrassing gaseous exchange.

The early symptoms of anorexia, cough, and tachypnea are not impressive but these quickly progress to severe dyspnea with cyanosis that is suggestive of the diagnosis. The authors emphasize the importance of roentgenography and the necessity of obtaining good films even though the infants may be in considerable distress. Prompt diagnosis, the administration of oxygen, and immediate surgical relief are the cardinal points in management. Aspiration of the cyst should be performed only when deepening cyanosis demands it, and not electively, because of the certainty of refilling and the possibility of pneumothorax as an additional complication.

The differential diagnosis involves five possibilities, roentgenographically: (1) congenital diaphragmatic hernia, (2) pneumatoceles secondary to staphylococcic pneumonia, (3) tension pneumothorax, (4) congenital lung cyst, and (5) congenital lobar emphysema.

In the authors' cases, surgical treatment presented no difficulty providing gaseous exchange was sufficient to permit anesthesia. All 6 of the patients had uneventful recoveries. The youngest was five days old.

Three roentgenograms.

R. F. LEWIS, M.D.
Cleveland Clinic

Extrapulmonary Intrathoracic Tumors. Clinical Manifestations and Surgical Treatment. Stuart W. Harrington. Minnesota Med. **36:** 953–960, September 1953.

A series of 211 extrapulmonary thoracic tumors is analyzed in this paper as to diagnosis, location, and etiology. Surgical aspects are covered rather briefly.

In the anterior mediastinum the tumors most frequently found are the various forms of teratoid neoplasms. Thymomas, cysts, lipomas, fibromas, thyroid adenomas, and various connective-tissue tumors are also seen.

In the posterior mediastinum (excluding the esophagus) the nerve tissue tumors are most common, namely, neurofibromas, some of which are of the "dumbbell" type with one part extending into the spinal canal, sympathiconeurofibromas, and gangliomas. A few cysts of bronchial or enteric origin also occur.

In the mid-thorax lymphoblastoma is the only neoplasm mentioned, but aneurysms and other cardiovascular abnormalities are encountered.

The superior mediastinum may show thymomas, goiters, neuroblastomas, aneurysms, cystic lymphangiomas, azygos lobe lesions, and superior sulcus tumors.

Inferiorly there are pericardial tumors, diaphragmatic hernias and tumors, and esophageal tumors and diverticula.

Roentgenologically, in the case of cystic or solid tumors, one can seldom do more than determine that a tumor is present and its location. A specific diagnosis can be made by one means or another (outlining the esophagus, bronchography, angiocardiography, kymography, etc.) in diaphragmatic hernia, aneurysms, and vascular anomalies.

Many intrathoracic tumors are productive of no symptoms, especially when benign. Pain, a sense of substernal pressure, cough, dyspnea, and pleural effusions may occur.

Etiologically the author's series was as follows:

Neuroblastomas: 50 neurofibromas (6 dumbbell; 3 malignant); 5 ganglioneuromas; 3 sympathiconeurofibromas	58
Cellular fibromas (7 malignant)	12
Teratomas (6 malignant, 13 dermoids)	43
Cysts	
Mediastinal (12 celomic, 20 endothelial, 4 lymphangiomas)	36
Bronchogenic	5
Thymomas (5 malignant)	20
Thoracic thyroid adenomas	16
Hemangioendothelioma	8
Granulomas	5
Hamartomas	1
Lipoma	4
Mesothelioma	2
Calcified hematomas	2

All of the tumors were removed surgically, but the results are not given beyond the statement that 7 patients died postoperatively. No follow-up is reported.

Ten roentgenograms; 2 photographs; 2 drawings.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Congenital Cysts and Cystic Tumors of the Mediastinum. Edgar H. Little. South. M. J. **46**: 742–748, August 1953.

The author discusses the various types of mediastinal cysts with particular emphasis on their roentgenologic differentiation, on the basis of an experience with 20 surgically proved cases.

Epidermoid, dermoid, and teratomatous cysts are similar roentgenographically. They are situated anteriorly in the mediastinum, not too far from the level of the hilar shadows. The presence of calcification in the cystic substance or wall is common as contrasted with lack of calcification in other types of cysts. Malignant change cannot be predicted from the roentgenogram, though it may be suggested by nodularity in association with appropriate clinical symptoms.

Pericardial cysts are usually in the inferior portion of the anterior mediastinum at the cardiophrenic angle. They are devoid of calcification and usually change their size and shape with changes in position and phases of respiration. This is in contrast with the dermoids and teratomas which are more constant in size and shape.

Bronchial cysts usually have a diagnostic position in the posterior mediastinum, commonly lying near or above the bifurcation of the trachea on its posterior surface. They are usually at or just anterior to the spine, whereas solid neurogenic tumors are generally in the costovertebral angle. The shadow, as a rule, is not as dense as that of a neurogenic tumor or teratoid cyst. The cyst is devoid of calcification and its usual intimate relationship to the trachea may allow it to move when the patient swallows. Most bronchial cysts produce symptoms early in life.

Lymphangiomatous cysts, commonly called cystic hygroma, are rare. There is essentially no histologic difference between lymphangiomatous and pericardial cysts. However, lymphangiomas are multilocular in contrast to the pericardial cysts, which are unilocular. Lymphangiomas are intimately incorporated with the various structures amid which they are situated, whereas pericardial cysts possess no significant growth attachment. Cystic lymphangiomas are situated higher in the anterior mediastinum than pericardial cysts and are often associated with cystic hygroma of the neck. The lymphangiomas do not contain calcium.

Esophageal and gastroenteric cysts are discovered early in life as posterior mediastinal masses, usually located in the region of the middle third of the esophagus, chiefly on the right. Their size and the early appearance of pressure symptoms aid in differentiating them from neurogenic tumors. Their extreme posterior position, smooth contour, and uniform roentgen density will aid in differentiation from dermoids and from pericardial and bronchial cysts.

Usually a definite diagnosis of the type of tumor cannot be made from the roentgenogram, and surgical exploration is indicated.

Fourteen roentgenograms. T. E. KEATS, M.D.
University of California

Bilateral Bronchiectasis. A Clinical and Physiologic Evaluation of the Results of Surgical Treatment. Edgar P. Mannix, Jr., Francis Gerbasi, Charles E. O'Brien, Richard H. Adler, W. Arnold McAlpine, and Harper Kerr. J. Thoracic Surg. **26**: 140–155, August 1953.

Technical and antibiotic advances have greatly reduced the surgical morbidity of lung resections for bronchiectasis. The incidence of emphysema, ventilatory insufficiency with hypoxemia, pulmonary hypertension and cor pulmonale following resection still require clarification. The disadvantages of a state of respiratory insufficiency postoperatively must be weighed not only against the handicaps as they exist before operation, but also against the amelioration of symptoms other than dyspnea following surgery. The authors report a series of 13 cases with the object of directing attention to the problem of respiratory insufficiency following extensive lung resections.

Three patients had pneumonectomy for extensive unilateral bronchiectasis but still had limited bronchiectasis in one segment of remaining lung. These 3 obtained symptomatic improvement without development or increase of dyspnea. Cough and productive sputum were substantially diminished, as were hemoptysis and respiratory infections.

Ten patients had between seven and thirteen pulmonary segments removed for bilateral bronchiectasis. Eight were improved (3 greatly, 4 moderately, 1 slightly). The symptoms most consistently ameliorated were productive cough and periodic attacks of pneumonia and sinusitis. Two of this group died in the late postoperative period. The others all had some evidence of respiratory insufficiency, primarily ventilatory in nature, which was severe in 5 patients. Dyspnea was newly developed or increased in 6 of the 9 patients who could be studied physiologically.

The 2 patients who died are of particular interest to the radiologist. The first patient died of an active tuberculosis fifteen months after a second operation, though periodic roentgenograms done before the operation were repeatedly interpreted as negative for that disease. The threat of active tuberculosis following lung resection for non-tuberculous disease is real. The literature reports tuberculosis in 1 of every 8 patients surviving resection for non-tuberculous bronchiectasis. The radiologist must therefore be especially watchful for this disease in patients on whom surgery is anticipated. Suspicion of tuberculosis may contraindicate operation.

The second patient who died had apparently been free of disease until five years before, when symptoms occurred following an attack of pneumonia. He had extensive honeycombing and pulmonary fibrosis. The lung left after operation provided only a limited intrapulmonary mixing of gases, with hypoxemia and marked ventilatory insufficiency. The possible occurrence of fibrosis following pneumonia should be familiar to radiologists, as there is a marked interference in alveolocapillary gas exchange.

It has been shown that there is only small reduction in vital capacity and inconsequential impairment in alveolo-capillary gas exchange after bronchography, unless an abnormally high gradient already exists. Of the authors' 10 patients who had bilateral resections, 4 had recent postoperative bronchograms. All became so severely dyspneic and cyanotic during the examination that the procedure was omitted in the remaining patients for fear of a fatality. These responses constitute evidence of a very low pulmonary reserve in these patients and serve to emphasize the danger of bronchography following extensive bilateral lung resection.

Seven roentgenograms; 7 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Silicosis, Bronchial Stenosis, and Emphysema. J.-L. Nicod. Schweiz. med. Wchnschr. **83:** 920–921, Sept. 26, 1953. (In French)

The case of a 52-year-old man who died of emphysema is reported. The history revealed considerable exposure to silica dust. At autopsy only micro-nodular lesions of silicosis were found in the pulmonary parenchyma, but the hilar nodes were greatly enlarged bilaterally and the lymphoid tissue was replaced by large masses of hyalinized fibrous tissue and small silicate nodules. It is concluded that bronchostenosis secondary to the greatly enlarged nodes gave rise to the emphysema.

One roentgenogram.

CHARLES NICE, M.D.
University of Minnesota

Radiologic Aspects of the Pulmonary Complications of Measles. G. Pisani and F. Toscano. Ann. radiol. diag. **26:** 287–302, 1953. (In Italian)

Pulmonary complications of measles are important in determining its prognosis, especially in early childhood. They are probably to be attributed to the measles virus itself as well as a superimposed bacterial infection. The authors' observations were made on 110 children during the autumn, winter, and spring of 1951–52. Some of these were admitted to the hospital for suspected pulmonary complications, with the primary disease already regressing; others were infants between one and two years in the hospital for other reasons. In this latter group the disease was observable in all its phases.

The authors divide the roentgenologic lung findings into three groups, none of which is pathognomonic for measles: (1) the reticulated pattern, with an increase in one or both of the hilar shadows, from which there extends a more or less fine reticulation, mainly toward the bases, without reaching the peripheral lung fields; (2) the miliary pattern, a regional or diffuse dissemination of minute nodular shadows of low density with indistinct contours, occasionally coalescing to form a larger shadow (rarely more than 1.0 cm. in diameter), at times homogenous and at times granular; (3) the infiltrative pattern, with parenchymal infiltration, irregular in form, extension, and density.

On the basis of the few autopsies done in the early stages of measles, these roentgenologic lung findings are attributed to an interstitial pneumonitis, acute bronchiolitis, and atelectatic-exudative processes. The reticulated pattern is probably due to infiltration in the interstitial peribronchial, perivascular, and perialveolar tissues, while the infiltrative pattern is the result of atelectatic-exudative processes, alveolar exudation and atelectasis incident to organic or functional obstruction of the bronchi and bronchioles. The miliary pattern is believed to be attributable to a terminal bronchiolitis with alveolar atelectasis with a mononuclear interstitial infiltration.

Fifteen roentgenograms; 1 table.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Occurrence of Histoplasmosis in Epidemics. Etiologic Studies. Michael L. Furcolow and J. Thomas Grayston. Am. Rev. Tuberc. **68:** 307–320, September 1953.

Thirteen epidemics of disseminated pneumonitis in which the etiologic agent was obscure were studied. Most of these epidemics had been reported under various names, as "cave sickness," "acute miliary pneumonitis," "granulomatous pneumonitis," etc. In many of the reports the etiology was not clear. In this study, the authors made use of skin tests, serologic tests, follow-up chest roentgenograms, and culture of soil for pathogenic fungi, in addition to clinical and roentgenographic findings.

The symptom complex was strikingly consistent, with sudden onset of malaise, chills, fever, and prostration, vague chest discomfort and non-productive cough. The acute illness lasted a few days to two or three weeks, with weakness continuing much longer. The typical roentgenographic changes usually developed after the first week and consisted of widespread discrete infiltrations varying in size from small granular lesions to nodules nearly a centimeter in diameter. Hilar adenopathy was present in many cases. Clearing occurred in two to six months, but a high percentage of patients showed pulmonary calcification of the disseminated miliary variety, and in some a generalized fibrosis persisted. Only 12 of 73 persons followed for at least four years failed to show calcification.

Skin tests with histoplasmin were positive in all 94 persons tested (116 persons were involved in the epidemics studied). This is significant, since some of the epidemics occurred in geographic locations where there was almost no histoplasmin sensitivity in the general population. Serologic tests were also significant, with all but one of 54 available sera obtained within three months of the onset reacting at least in a low titer. With the passage of time, the high titers decreased. In eleven of the epidemics, *Histoplasma capsulatum* was isolated in soil samples collected at the exact point source of the outbreak.

While the evidence presented is indirect and might be inconclusive in a single case, the similar findings in several series of cases seemingly provides conclusive evidence of histoplasmosis.

Eight roentgenograms; 1 map; 3 tables.

JOHN H. JUHL, M.D.
Minneapolis, Minn.

Report of a Case of Systemic Moniliasis. Sister Mary Antonia Klapheke and J. S. Harter. Dis. of Chest **24:** 332–335, September 1953.

The authors' patient was an acutely ill white woman of 54, with numerous granulomatous lesions of the skin and mucous membranes, particularly about the lips. Chest films showed a heavy wedge of infiltration in the left upper lobe posteriorly. Additional patches of increased density were found at both bases and in the right upper lobe. Pulmonary tuberculosis affecting the posterior segment of the left upper lobe primarily, with scattered infiltration elsewhere, was suggested as a diagnosis. This was supported by a history of weight loss and anorexia of several months, following pleurisy, and recent production of blood-tinged sputum and night sweats. No response to broad spectrum antibiotics was obtained.

The cutaneous and mucosal lesions were considered by a dermatologic consultant to be manifestations of an infectious granuloma. Biopsy confirmed this view, and further clinical study led to the opinion that both the cutaneous and pulmonary lesions were due to a fungous infection. This proved resistant to therapy and the patient died. Autopsy demonstrated involvement of the lungs, spleen, and kidneys by a granulomatous process showing fungi characteristic of *Monilia*. The

spleen was particularly interesting, showing the fungi growing in large colonies.

This case of systemic moniliasis should alert the radiologist to the rising incidence of mycotic infections, the chest x-ray appearance of which can be a real problem.

Six illustrations, including 2 roentgenograms.

D. DEF. BAUER, M.D.
Coos Bay, Ore.

THE CARDIOVASCULAR SYSTEM

On the Right Anterior Oblique Position in Angiocardiography. A. Castellanos and O. García. Rev. cubana pediat. **25**: 429–454, July 1953. (In English)

The authors describe the results of their efforts at diagnosis of the most commonly encountered anatomical forms of congenital cardiopathies in infancy by use of the oblique position, with the right side next to the film. At first they employed a slow film-changing cassette, but for the last two years they have used an apparatus permitting serial films at the rate of two per second.

In cases of persistence of the ductus arteriosus, the right oblique projection is much superior to other positions. In pulmonary stenosis the anatomic site of the narrowing can be visualized. In lesions of the mitral valve, congenital or acquired, this projection is excellent for obtaining precise information concerning morbid conditions of the left auricle. Results in the tetralogy of Fallot and in Eisenmenger's complex are equal to those obtained in the left anterior oblique position and much superior to those obtained in the frontal projection. In complete transposition of the vessels and with a persisting common arterial trunk, the right oblique projection is superior, although here the individual problem sometimes requires special radiological positions. The frontal and the left anterior oblique projections are better in tricuspid stenosis, but the right oblique is superior for the angiocardiographic diagnosis of persistence of the ductus arteriosus, reference being made to the cases where the shunt is from the aorta to the pulmonary vessel. The position is also valuable for detecting cases of interventricular communication of medium and large diameter.

Twenty-one illustrations. JAMES T. CASE, M.D.
Santa Barbara, Calif.

On the Value of Retrograde Aortography in the Study of Congenital Cardiac Lesions Operated. A. Castellanos, O. García, and R. Pereiras. Rev. cubana pediat. **25**: 413–428, July 1953. (In English)

In this communication, the authors, two of whom (Castellanos and Pereiras) devised the method, demonstrate the superiority of retrograde aortography over angiocardiography as a check on the permeability of a surgical anastomosis done by the Pott, Taussig-Blalock, or other vascular procedure. Naturally, a well performed cardiac catheterization permits determination of the degree of permeability or occlusion of the anastomosis performed for the purpose of increasing the circulating minute-volume of the pulmonary territory, through a careful study of the pulmonary blood saturation and its corresponding pressure. But superior or thoracic aortography makes it possible to demonstrate graphically the anatomic characteristics of the blood vessels that go to form the anastomosis, as well as other important details. Closure of the anastomosis is easily recognized on the roentgenograms; on the other hand, the degree of permeability can also be determined.

In cases of multiple malformations, such as the tetralogy of Fallot, where the aorta overrides the ventricular septum, the dextro-angiocardiogram gives rather diffuse images due to the passage of some of the contrast substance into the stenotic pulmonary artery, and the anastomosis is not well defined; in addition, the overriding aorta is not adequately opacified, due to the fact that the blood from the right ventricle is mixed with that of the left ventricle, which is not radiopaque. All of these factors contribute to make it impossible to obtain a good roentgenogram, no matter what position is used. On the contrary, the rapid injection of a contrast medium within the aortic arch, as is accomplished in thoracic or superior aortography, results in exclusive opacification of the aorta, its branches, and the arterial branch used in the surgical anastomosis. This supplies a good clean contrast and easy determination of the permeability of the arterial branch used.

Four roentgenograms. JAMES T. CASE, M.D.
Santa Barbara, Calif.

The Diagnosis of Aortic Insufficiency in the Living Subject and the Cadaver by Means of Retrograde Aortography. A. Castellanos and O. García. Rev. cubana pediat. **25**: 455–470, July 1953. (In English)

The authors reasoned that if in the living subject with aortic insufficiency there is regurgitation or reflux of blood from the aorta to the left ventricle, this should be demonstrable in the cadaver, providing not more than two or three hours has elapsed from the time of death. The injection must be made with some radiopaque solution in adequate amount, as quickly as possible, and with enough pressure to cause a reflux into the ventricular cavity. Obviously retrograde aortography is the method of choice for this purpose. A 12- or 10-gauge B.D. trocar is ideal. It is quite easy to introduce a trocar of this size into any of the branches of the aortic arch and inject a sufficient volume of solution, rapidly, in one and a half seconds, making the exposures seriographically, as in the living subject. In the cadaver, an 80 to 100 per cent solution of sodium or potassium iodide suffices. The volume of the liquid needed is as follows: 15 c.c. for newborn; 20 c.c. for infants of six to twenty-four months; 25 to 30 c.c. for children of two to six years; never less than 50 c.c. for adults and, if the aorta is dilated, 80 to 100 c.c. The left anterior oblique projection is preferable; the ventral view is inappropriate. Both obliques and the lateral view are perfect for visualization of the semilunar and subaortic regions and the left ventricle itself.

The authors are firmly convinced that retrograde aortography has a decisive value in the diagnosis of aortic insufficiency both in the living subject and in the cadaver. Intra-vitam aortography permits a correct differentiation of an interventricular communication complicated by an aortic insufficiency from a ductus arteriosus complicated by insufficiency of the semilunar valves, or from an aortico-pulmonary aneurysm caused by a septal defect with or without pulmonary insufficiency. In the case of interventricular communication with aortic insufficiency, aortography shows the artery and the entrance of the contrast solution into the left ventricle, and there is no visualization of the pulmonary artery. In a case of arteriovenous aneurysm without aortic insufficiency, the aorta and the pulmonary artery would be shown but the left ventricle

would be empty. In the presence of aortic insufficiency complicating a persistence of the ductus arteriosus, the aorta, pulmonary artery and its branches, and also the left ventricle would be demonstrated.

JAMES T. CASE. M.D.
Santa Barbara, Calif.

Aortography: Leriche's Syndrome. Italo Gigante and Manfredi. Arch. radiol. **28:** 412–415, 1953. (In Italian)

Histopathologic and aortographic examinations have shown that thrombosis obliterating the bifurcation of the aorta usually begins in one of the common iliacs, extends across the bifurcation, and gradually progresses into the opposite common iliac artery. The thrombosis can be propagated upward toward the origin of the inferior mesenteric artery and may even reach the openings of the renal arteries. When the syndrome is completely developed, the lumen of both iliacs and of the aorta is completely obliterated by a large thrombus strongly adherent to the thickened walls. The gradual process of obliteration determines the appearance of the following clinical characteristics: (1) faulty penile erection, due to a circulatory deficit in the corpora cavernosa; (2) extreme fatigability of the lower limbs, with muscular atrophy; (3) pallor in the limbs when they are elevated; (4) absence of femoral pulse; (5) elevation of arterial pressure in the upper extremities.

The blood supply to the lower limbs is effected by collateral circulation between the lumbar arteries (branches of the abdominal aorta) and the iliac circumflex, ileolumbar and epigastric arteries.

The disease evolves in two stages: The first lasts from ten to twenty years, during which the obliteration of the aorta is compensated by collateral circulation. In this stage, weakness of the legs and poor erection are the manifestations. Slowly, muscular atrophy and disappearance of the femoral pulses supervene. In the second stage, the patient is unable to walk any distance, and the severe pains are commonly interpreted as a polyneuritis. Leriche warns against making such a diagnosis without first examining carefully the femoral pulse and studying the oscillometric curve.

Recognition of this condition is not difficult, and aortography will allow a precise anatomic diagnosis, as well as visualization of the collateral circulation. The aortography is done under general anesthesia, according to the technic of Dos Santos. Four cases with surgical confirmation are presented.

Four roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Applicability of the Sum of the Transverse and Depth Diameters in the Determination of the Size of the Heart. William H. Christ. Radiol. clin. **22:** 433–444, September 1953. (In German)

The author examined 200 healthy males, using several formulae for determination of the size of the heart. He tested the application of these formulae as regards the volume of the heart, the transverse diameter, and the sum of the transverse and depth diameters.

The minimum average variation from the predicted normal for the volume was 11.2 per cent, for the transverse diameter 5.6 per cent, and for the sum of the transverse and anteroposterior diameters, 3.9 per cent. When the age and body size were taken into consideration, the variations between the predicted normals and the actual measurements were not as marked, decreasing by 29.8 per cent when the transverse and anteroposterior diameters were used, by 17.1 per cent when the transverse diameter was used, and by 14.7 per cent when the expected volume was ascertained.

The author concludes that the sum of the transverse and anteroposterior diameters is the most accurate measure for evaluating the size of the heart, and that the weight, height, age, transverse and depth diameters of the thorax should be considered in arriving at the predicted value.

Three tables.

JULIAN C. SALIK, M.D.
Baltimore, Md.

The Diagnosis of Mitral Regurgitation. An Evaluation of Clinical Criteria, Fluoroscopy, Phonocardiogram, Auricular Esophagogram and Electrokymogram. Walter H. Abelmann, Laurence B. Ellis, and Dwight E. Harken. Am. J. Med. **15:** 5–24, July 1953.

The importance of differentiating "mild" mitral regurgitation from "marked" regurgitation in the selection of patients for operation for mitral valve lesions led the authors to a study of certain clinical findings and diagnostic methods which might be of use for this purpose Their observations were made on 63 patients who underwent mitral valvuloplasty. Radiological criteria covered by the study included heart chamber enlargement and systolic expansion of the left auricle as demonstrable fluoroscopically.

Definite left ventricular enlargement demonstrated either by radiography and fluoroscopy or in the electrocardiogram, in the absence of aortic valvular disease, hypertension, or myocardial failure, speaks for predominant mitral regurgitation, although severe stenosis may occasionally coexist. Aneurysmal dilatation of the left auricle indicates marked to predominant mitral regurgitation, while very large left auricles may on occasion be seen with stenosis as the predominant lesion. Definite systolic expansion of the left auricle on fluoroscopic examination when seen in the postero-anterior projection is presumptive evidence of marked mitral regurgitation. In the oblique position this sign may be apparent in tight mitral stenosis and it may be absent in marked regurgitation. It has not been seen in patients without heart disease or in patients with functional apical systolic murmurs.

In order to determine if a combination of criteria would render the diagnosis of mitral regurgitation more dependable than any single criterion, the degree of stenosis found at operation was correlated with the following findings, singly and in all possible combinations: (1) apical systolic murmur of grade 3 or more, (2) pronounced left auricular enlargement, (3) left ventricular enlargement, and (4) systolic expansion of the left auricle as demonstrated fluoroscopically. When this was done for 47 patients on whom fluoroscopic observations of auricular pulsations were available, it was found that any two of the above four criteria were met by 71 per cent of those with marked regurgitation, 63 per cent with mild to moderate regurgitation, 25 per cent with questionable regurgitation, and 6 per cent of those with pure stenosis.

In conclusion, the feasibility of correct preoperative diagnosis of marked mitral regurgitation in most cases of mitral valvular disease under consideration for valvuloplasty is reasserted. No single criterion may be relied upon; consideration of all clinical findings usu-

ally allows correct assessment of the individual patient.

Two illustrations; 8 tables.

Diagnosis and Surgical Removal of Intracavitary Myxoma of Right Atrium. Henry T. Bahnson and Elliot V. Newman. Bull. Johns Hopkins Hosp. **93**: 150–163, September 1953.

Myxoma of the heart occurs frequently enough to be considered in the differential diagnosis of atrioventricular obstruction. Approximately 150 such tumors have been reported. The clinical picture in many of these is distinctive enough to suggest the diagnosis during life, but the authors knew of only 3 cases recognized before operation or death.

Although intracavitary tumors are not always associated with symptoms, most of the reported cases present some features of a characteristic syndrome. Signs of obstruction or regurgitation at the atrioventricular valve are usually seen and are strikingly variable with both time and the position of the patient. Syncope and tachycardia have been noted with change in position and intermittent occlusion of the mitral valve. Dyspnea may be intermittent and paroxysmal, but often becomes progressive and severe. Peripheral embolic phenomena, with occlusion of major vessels, are not infrequent. In no case has surgical removal been successful, although many features make the tumor amenable to surgery.

The authors report a fourth case diagnosed preoperatively, in a patient with a history of intractable cardiac inflow stasis and limited cardiac output. Diagnosis was made by cardiac catheterization and confirmed by angiocardiography. The latter procedure showed a dilated superior vena cava and a large filling defect, 6 × 5 cm., in the right atrium. Contrast substance remained in the right atrium for at least twelve seconds. Removal of the tumor was performed surgically. The patient died twenty-four days after operation, probably largely because of atrial obstruction from a fragment of residual tumor, although a pelvic hematoma from an attempted arterial transfusion, postoperative gastric dilatation, and electrolyte disturbances added to her difficulties.

Three roentgenograms; 3 drawings; 1 photograph.

HOWARD L. STEINBACH, M.D.
University of California

Radiokymography in Interauricular Septal Defect. Two New Signs in the Diagnosis of This Congenital Anomaly. Jorge Meneses Hoyos. Radiología (Panama) **3**: 175–184, September 1953. (In Spanish)

Two new signs for the radiologic diagnosis of defects of the atrial septum are proposed: (1) Increased pulsation of the left atrium, though detectable by fluoroscopy, was accurately shown only by kymography in the left oblique view (55°). This radiological sign is not to be found in cases of ventricular septal defect nor of patent ductus arteriosus. (2) The form of the radiokymographic or the electrokymographic waves in the prominent middle arch (left side of the cardiac silhouette in the anterior posterior view) permits the establishment of an "auricular," "ventricular," or "vascular" origin, by comparison with waves shown by the left ventricular and the aortic arches. "Auricular" waves are to be found only in cases of atrial septal defect, and in some patients with mitral stenosis. "Ventricular" waves are observed most often, and in many different conditions: mitral stenosis, pulmonary stenosis with closed ventricular septum, and defects of the atrial or ventricular septum. "Vascular" waves are to be seen in cases of patent ductus arteriosus, Lutembacher's syndrome, or of Eisenmenger's complex.

The radiologic picture of atrial septal defect (enlarged right auricle, right ventricle, and pulmonary artery, small left ventricle and aorta, increased pulsating hilar shadows) is not distinctive, as it may be found in Lutembacher's syndrome and in Eisenmenger's complex, and in some patients with a defect of the ventricular septum. The picture is similar to that of patent ductus arteriosus. Differential diagnosis of these anomalies may be easier clinically than by roentgenography. The two new radiokymographic signs proposed may be valuable for the differential x-ray diagnosis. They were observed in 3 cases of atrial septal defect in which radiokymography was applied. The diagnosis rested on both the clinical picture and the data furnished by various instrumental methods.

Four roentgenograms; 4 roentgenkymograms.

JONAS BRACHFELD, M.D.
University of Pennsylvania

The Diagnosis of Overriding Aorta, with Special Reference to Circulation Time Tests. Alvin J. Gordon, Richard P. Lasser, Howard L. Moscovitz, Sigmund A. Brahms, and Frederick H. King. Am. J. Med. **15**: 158–170, August 1953.

Though this paper is concerned largely with a circulation time test employing Evans blue dye, other methods of diagnosing an overriding aorta are reviewed, including angiocardiography. The significance of a right aortic arch in a cyanotic patient with congenital heart disease in relation to overriding aorta is also discussed.

The anatomic position of an opacified aorta relative to the two ventricles may suggest that the aorta arises in whole or in part from the right ventricle, but this is not regarded as a reliable criterion. Premature visualization of the aorta in the course of angiocardiography is also suggestive of overriding but this may occur in other conditions in which the aorta receives its blood exclusively from the left ventricle.

With rare exceptions, the presence of a right-sided aortic arch in association with cyanosis indicates that the aorta arises in whole or in part from the right ventricle.

A case is presented exemplifying some of the difficulties of the diagnosis or exclusion of an overriding aorta and affording an illustration of the fact that it is erroneous to assume the presence of an overriding aorta because opacification of that vessel occurs at a time when the left ventricle is not visualized.

Six roentgenograms; 3 tables.

The Radiological Diagnosis of Aortic Sinus Aneurysma. S. F. Oosthuizen. South African M. J. **27**: 869–872, Oct. 3, 1953.

Aortic sinus aneurysms may be congenital or acquired. It is unlikely that congenital aneurysms can be diagnosed radiologically, as they project into the heart. Acquired aneurysms, on the other hand, project externally and cause an alteration in the cardiac contour, demonstrable on the roentgenogram.

The author reports two cases of the acquired type, which were suspected radiologically. The first oc-

curred in a 30-year-old male. There was marked cardiac enlargement, and a prominence was present on the upper mid portion of the right heart border which pulsated actively in inverse relationship to the greatly enlarged left ventricle. Autopsy revealed aneurysmal dilatation of the anterolateral ascending aorta with involvement of the aortic sinuses and aortic insufficiency. Microscopically, there was cystic necrosis of the media of the aorta.

The second patient was an elderly male with similar roentgen findings. Autopsy revealed an aneurysm (syphilitic) of the ascending aorta involving the aortic sinuses.

Acquired aneurysms may arise from any of the three aortic sinuses. They are usually large and should be recognized radiologically, as the appearance of the heart is fairly characteristic, having been described as "sickle-shaped."

The majority of acquired aortic sinus aneurysms are due to syphilis. Rheumatic aortitis has been held responsible in one reported case and arteriosclerosis has been mentioned as a possible cause. The author's initial case is the first to be described as the result of idiopathic cystic necrosis.

Three roentgenograms; 2 photomicrographs; 1 electrocardiogram. M. HARLAN JOHNSTON, M.D.
Jacksonville, Fla.

Transposed Pulmonary Veins. A Correlation of Clinical and Cardiac Catheterization Data. David C. Levinson, George C. Griffith, Richard S. Cosby, Willard J. Zinn, George Jacobson, Sim P. Dimitroff, and Robert W. Oblath. Am. J. Med. **15**: 143–157, August 1953.

The clinical diagnosis of anomalous pulmonary venous drainage was not possible until the advent of cardiac catheterization and angiocardiography. Without these special technics, patients with this anomaly are clinically indistinguishable from those with isolated atrial septal defects or with normal hearts.

Ten cases of pulmonary vein transposition are here reported. In 4 patients with partial and 2 with complete transposition of the pulmonary veins the cardiac catheterization and clinical findings are correlated. The other patients presented (1) pulmonary valvular stenosis accompanied by partial pulmonary vein transposition; (2) a left superior vena cava entering a sinus venosus in common with the hepatic veins, accompanied by anomalous drainage of the right pulmonary veins into the right atrium; (3) probable tricuspid atresia with partial pulmonary vein transposition (2 cases).

The diagnosis of anomalous pulmonary vein drainage in these cases was made at cardiac catheterization by roentgen visualization of the catheter in the anomalous vein, by a characteristic pulmonary vein pressure curve, and finally by 90 to 95 per cent oxygen saturation in the blood sample from the anomalous vein.

Roentgenograms of the chest showed increased prominence of the pulmonary artery segment in most instances. At fluoroscopy most of the patients had increased pulsations of the pulmonary arteries. These findings were most evident in the patients with complete transposition. Right ventricular enlargement was minimal in those with uncomplicated partial transpositions and more marked in those with complete transposition.

Angiocardiography in 5 patients was of no aid in detecting the anomalous pulmonary vein or the presence of an atrial septal defect, which must have existed in the patients with complete transposition. In every instance angiocardiography confirmed the presence of pulmonary artery dilatation, which was most marked in the 2 patients with complete transposition.

The authors believe that surgery is best reserved for those patients with complete transposition accompanied by increasing limitation of physical activity. Usually surgery is not indicated for partial transposition.

Eight roentgenograms; 1 electrocardiogram; 3 pressure tracings; 11 tables.

Significance of Damage to the Arterial System in the Development of Varicosities. E. Vogler. Fortschr. a. d. Geb. d. Röntgenstrahlen **79**: 354–368, September 1953. (In German)

The author has studied 160 cases of varicosities by means of arteriography and has come to the conclusion that the major cause for their development probably lies in damage to the arterial system. It was found that spasm in the precapillaries can produce a marked dilatation of pre-existing arteriovenous anastomoses, shunting a good deal of the arterial blood through the anastomoses directly into the venous system. Thus the venous pressure is markedly increased, and dilatation may result.

The author's method of examination involves two arteriographic studies on every patient. At first a contrast medium is injected into the artery and at least three films are taken, one each in the arterial, capillary, and venous phase. These serial films allow a careful study not only of the three constituents of the circulation, but also of their functional cooperation. In most of the cases it has been possible to demonstrate a narrowing of the precapillaries. In order to find out whether this narrowing is of a functional or of an organic nature, the second study is made after the intra-arterial injection of a vasodilating drug (Hydergin). Again films are taken in the arterial, capillary and venous phases.

In all 160 cases, changes in the arterial circulation were demonstrable, chiefly in the precapillaries, but also in the main arterial stems. It could be shown that in the presence of a narrowing of the precapillaries, a shunting of arterial blood through arteriovenous anastomoses occurred regularly. The larger anastomoses could be directly demonstrated on the x-ray film. The smaller ones could not be seen, but the shunting could be deducted from the fact that a premature filling of the veins occurred before the end of the arterial phase. It was further demonstrated that, if the changes in the precapillaries were of a functional nature, or still reversible, the administration of a vasodilator (Hydergin) would produce a normal circulation in the capillaries. The arteriovenous anastomoses would close and the venous phase would show normal filling. In other words, the previously dilated veins would become narrower. Apparently the arteriovenous anastomoses become active only if there is an obstacle in the precapillary circulation. If, however, the narrowing of the precapillaries has become irreversible, the administration of Hydergin will no longer produce a diminution of the lumen of the veins. The superficial subcutaneous veins become permanently dilated and the increased pressure within the venous circulation will continue to work upward toward the large venous trunks.

When the process has reached the large valves in the veins, rendering them incompetent, the system of large varicosities may become detached from the arterial circulation and show a reversed flow. The deep circulation over the femoral vein, for instance, may still be intact, but at the junction of the saphenous and femoral veins the blood stream is reversed. The blood circulates downward through the incompetent valve and is re-absorbed again, lower down, through the communications between the superficial and the deep veins. This reversed circulation was definitely proved by the injection of radiopaque material into the saphenous vein with the patient standing and its demonstration lower down. Also methylene blue injected high up in the saphenous vein could be recovered shortly afterward in the superficial varicosities of the lower leg.

The author also believes that the disturbance of the circulation in the precapillaries with subsequent marked impairment of the capillaries is responsible for the various skin changes and may play a large part in the development of the so-called varicose ulcer, the varicose veins themselves being only a secondary cause.

This article is written in a very convincing, logical form. The illustrations are excellent, and for those interested in this phase of arteriographic examination, a closer study of the original text may prove of interest.

Nineteen roentgenograms.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Venous Blood Flow During the Valsalva Experiment Including Some Clinical Applications. Samuel Candel and David E. Ehrlich. Am. J. Med. **15**: 307–315, September 1953.

The venous pathways of the arm, neck, and chest of 52 normal young men were studied. Venograms were obtained with and without the performance of the Valsalva maneuver. During the Valsalva maneuver the radiopaque substance was frequently arrested at the level of the first rib. These venograms resembled those obtained in patients suffering from venous occlusion of the axillary or subclavian vein. There was a retrograde flow of radiopaque substance around the shoulder joint and into the veins of the neck.

In view of these observations, the authors advise that, in the course of venography for the purpose of diagnosis of venous occlusion, precautions be taken to avoid an unintentional Valsalva maneuver on the part of the patient. Otherwise the venogram of a normal venous system may exhibit all the features of venous occlusion. It is possible that the arrest of blood flow and increased venous pressure at the level of the first rib during the Valsalva maneuver may contribute to the occurrence of axillary or subclavian vein thrombosis during effort.

Ten roentgenograms.

HOWARD L. STEINBACH, M.D.
University of California

Contribution to the Study of Portography. Paul Loewe, Rafael Saenz Arroyo, and Pablo Steimle. Rev. mex. de radiol. **7**: 119–133, March-April 1953. (In Spanish)

In 20 cases of portal hypertension the authors injected a 70 per-cent Ioduron solution directly into the spleen. The procedure is easy when the spleen is enlarged but difficult when it is of normal size. It is useful for testing the portal vein for permeability and is of value in differential diagnosis.

Fifteen roentgenograms.

E. KRAFT, M.D.
Newington, Conn.

THE DIGESTIVE SYSTEM

New Results of Roentgen Studies of Digestion. E. Muntean. Fortschr. a. d. Geb. d. Röntgenstrahlen **79**: 329–332, September 1953. (In German)

In order to test the digestive function of the gastrointestinal tract, particularly the digestion of proteins and of fats, Leb used small pills made of water-soluble barium coated with a thin layer of protein or fat, which was dissolved only by the fermentative action of the gastric and intestinal juices (Fortschr. a. d. Geb. d. Röntgenstrahlen **75**: 106 (Sonderheft), December 1951. Abst. in Radiology **60**: 128, 1953). The minute the coating is dissolved, the pill falls apart and the distributed barium becomes visible on the x-ray film.

Pills for the study of the fermentative action upon proteins and fats are now commercially manufactured by the firm Byk-Gulden in Konstanz. The author, who was formerly associated with Leb, has tested this new method of examination on 103 patients. On each of these patients a routine gastrointestinal x-ray examination had been done first, as well as a cholecystography and a determination of gastric acidity.

The following conclusions are reached:

Digestion of Proteins: A patient with a normal acidity will digest the barium pills coated with protein in one hour and fifty-four minutes. In the presence of anacidity or subnormal acidity, the period necessary for digestion is prolonged, possibly on account of longer retention in the stomach. If the stomach has been resected, however, the period of digestion is practically normal, probably because the tryptic phase of digestion in the small intestine begins earlier on account of the rapid emptying of the stomach, compensating for the lack of gastric digestion. With hyperacidity, the period of digestion is markedly diminished, on an average to one hour and thirteen minutes, but occasionally to twenty-five or thirty minutes within the stomach. These findings were so reliable that in the presence of rapid digestion of the pills within the stomach a diagnosis of hyperacidity could be made with certainty.

Fat Digestion: The digestion of barium pills coated with fat normally required, on an average, two hours and twenty-one minutes. A prolongation of the digestion period was found in the presence of diminished acidity and also, strange to say, in cases of hyperacidity, as well as in gallbladder disease (non-visualization of the gallbladder) and in patients who had had a stomach resection. While the prolongation of the period in cases of diminished acidity may well be due to the longer retention of the pills within the stomach, no absolutely reliable explanation has been found for the prolongation in case of hyperacidity. Inasmuch as this prolongation is demonstrable also in cases of hyperacidity after a stomach resection, the author believes that possibly the underlying condition responsible for the hyperacidity may at the same time produce some disturbance in fat digestion. In the presence of gallbladder disease, the time of fat digestion was prolonged to an average of two hours and forty-four minutes.

Four roentgenograms; 4 graphs.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Considerations on Megaesophagus. C. Rimondini. Radiol. med. (Milan) **39**: 841–862, September 1953. (In Italian)

The author reports on 51 cases of megaesophagus examined since 1933. Dysphagia is the predominating symptom, recurring at successively shorter intervals and with greater intensity. Even with small quantities of food, the patient experiences a retrosternal oppression, with dyspnea and at times anginal pain. He finds that sipping water, flexion of the head, deep inspiration, and bearing down against a closed glottis help empty the esophagus. Vomiting then supervenes, at times of food eaten several days previously. The breath is fetid. Not infrequently in the advanced stages hiccoughing occurs, perhaps due to the irritation of the diaphragm or of the phrenic nerve from the dilated esophageal sac. Similar mechanisms may cause costal neuralgia, dyspnea, cough, anginoid crises, all expressions of disturbances from compression of the mediastinal organs. This picture is the typical one, and presents no difficulty in diagnosis, but at times the differential diagnosis between megaesophagus and cardiac tumor may be extremely difficult, if not impossible.

The radiologic picture of an elongated and tortuous esophagus, with delay of the barium at its terminal end and evidences of retained food is characteristic. Study of the distal segment will permit the differential diagnosis between a functional and organic stenosis. When the cardiac canal is closed there is sharp separation between the esophagus and the stomach. The lower esophagus may take several forms: it may be cigar-like or cone-like, but never funnel-like as in stenoses from caustics. The cardiac canal opens only when the barium column has reached a certain level, which is more or less constant. Usually the esophagus empties in rhythmic spurts, only rarely in one massive descent. The forms assumed by the cardiac canal have been described by various authors as "root-like," "rat-tail," "toad-tail," or "awl-point." These appearances, however, are not characteristic for megaesophagus. Much more important in the diagnosis, especially in contradistinction to tumor, is the regularity and pliability of the esophageal wall. It is principally on this that the diagnosis is made. The caliber of the cardiac canal varies during the examination, and when it dilates one observes a normal mucosal pattern.

While the barium enters the stomach in rhythmic jets in megaesophagus, in neoplastic disease the entire esophagus will empty after a certain level is reached. The caliber of the esophagus in megaesophagus is usually greater than in neoplasm. The reason for this lies not in the differences in duration of the two processes, as has been generally assumed, but rather in the hypotonia of the megaesophagus resulting from dysfunction of the autonomic nervous system.

The author discusses the many theories of origin of this condition, and favors autonomic imbalance.

Of the 51 patients in the series reported here, 18 underwent surgery, and in 12 of these a gastric or duodenal ulcer was discovered. The vegetative nervous imbalance, which explains megaesophagus by the incoordination between peristalsis and the opening and closing of the cardia, is also invoked to explain the occurrence of peptic ulcer in these cases.

Twenty-eight roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

The Nature and Treatment of Plummer-Vinson Dysphagia. J. A. W. Bingham and J. S. Logan. Brit. M. J. **2**: 650–652, Sept. 19, 1953.

Upper esophageal dysphagia due to webs or constrictions in the cervical part of the esophagus, associated with an iron-deficiency anemia, is relatively common in the north of Ireland, from which this report comes. The authors' observations are based upon 16 cases seen over a five-year period. The site of the obstruction is either at the level of the cricopharyngeal sphincter or immediately beyond it. Often the stenosis extends for as much as a centimeter along the esophagus.

Since the difficulty in swallowing is in the initiation of the act, the patients are often considered hysterical, and indeed the narrowing may be overlooked at fluoroscopy unless special care is taken. A barium suspension of creamy consistency should be used, and the patient should be turned into the left oblique position till the air-filled pharynx and trachea and the retrotracheal space clear the spine. The observer must concentrate his attention upon the upper 2.5 cm. of the esophagus. If the patient then swallows a mouthful of barium the abnormality may be seen for as long as three or four seconds, but no longer. In most cases there is a general narrowing at the beginning of the esophagus, pronounced enough in severe cases to produce a cuff-like appearance. In addition, most cases, when viewed laterally, show the familiar web appearance. The chief role of radiology is to exclude cancer lower down or in the stomach.

The syndrome is a precursor of carcinoma. This sequela was observed in 2 of the present series. Treatment is by dilatation of the stenosis, with iron for the anemia.

Three roentgenograms; 1 table.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

The "Normal" Radiographic Adult Stomach and Duodenum. A Study of Their Contour and Size and Their Critical Relationships to the Spine in Both Symptomatic and Asymptomatic Individuals. Isadore Meschan, Harold Landsman, George Regnier, H. Wendell Ward, B. Gilliam Brogdon, and Chalmers S. Pool. South. M. J. **46**: 878–886, September 1953.

The stomachs and duodenums of 211 adults between thirty and seventy years of age were studied in an attempt to analyze the normal configuration and position of the stomach. One hundred and seven of the subjects were asymptomatic; the remaining 104 subjects were patients who had been under observation for upper gastrointestinal complaints but in whom no apparent radiographic abnormality was found.

The patients were classified as normal in weight, underweight, or overweight, and in each of these groups four major stomach types were considered. These types were coded: (1) the "J" shaped or eutonic stomach, in which the pylorus and incisura angularis are at the same level; (2) the cascade stomach; (3) the fish-hook or hypotonic stomach, in which the incisura angularis is considerably lower than the pylorus; (4) the steer-horn stomach, in which the incisura angularis is above the level of the pylorus.

Numerous measurements were made of the stomach and duodenum and of their relationships to surrounding structures. The tabulated results show significant tendencies toward pathologic function, which are summarized as follows:

(1) The symptomatic stomach tended to be larger than its asymptomatic counterpart, except in the cascade type.

(2) In the symptomatic category there was a lesser incidence of the eutonic stomach in the normal and overweight subdivisions, and a greater incidence of steer-horn and fish-hook type stomachs in the normal and underweight groups.

(3) Cascade stomach, when present in the symptomatic group, occurred more frequently in overweight individuals, and in these individuals the stomach seemed cramped in its external relationships.

(4) The steer-horn stomach in anyone other than an overweight individual is probably of symptomatic significance.

(5) There are certain measurements for the size of the stomach which are recorded as probably representing the upper limits of normal, and when exceeded are probably associated with symptoms, either primarily or secondarily.

(6) There are certain distances of the stomach and duodenum from the spine which have been expressed arithmetically for each type of stomach in each weight group. If these 12 stomach type-weight groups are borne in mind when measurements are applied, their interpretation in the light of disease of extragastric structures is possible.

(7) Measurements are also given for the relationship of the fundus of the stomach to the left leaf of the diaphragm; the diameter of the second part of the duodenum; the widths of the rugae of the stomach and mid-duodenum; the spinal levels of the duodenal bulb and ligament of Treitz, and the number of gastric peristaltic waves.

The authors hope to study many more cases in their attempt to place these observations on a firmer footing.

Eighteen drawings; 4 tables. T. E. KEATS, M.D.
University of California

Gastric Ulcer: Its Diagnosis and Differentiation by Gastroscopic and Roentgenological Examination. L. L. Hardt, F. Steigmann, and A. Weiss. Am. J. Digest. Dis. **20**: 253–257, September 1953.

A comparison of findings on gastroscopy and roentgen examination of the stomach was made in 203 cases of gastric ulceration in which both procedures were used. Final diagnoses were based on surgery (72 cases) or sufficiently long medical follow-up to assure benignity. In only 110 out of the 203 cases did the two methods agree. In the 131 patients treated medically the lesion was detected by both methods in 69 cases, by x-ray alone in 20, by gastroscopy alone in 42. In the 72 patients treated surgically, the methods agreed (as to the presence of a lesion) in 41. X-ray alone made the diagnosis in 11, gastroscopy in 19.

A study was also made of the value of the two methods in differentiating between benign and malignant lesions. Histologic proof of benignity was available in 56 cases. In 20 of these the ulcer was regarded as benign on x-ray examination, in 19 as malignant, and in 17 no commitment was made. On gastroscopy, 22 were reported benign, 12 as malignant, and 22 undetermined. Three of the histologically proved malignant ulcers were diagnosed as benign on both radiology and gastroscopy. A correct diagnosis was made radiologically twice, and gastroscopically 4 times. In the remainder the nature of the lesion was undetermined.

The principal cause for x-ray failure in the recognition of an ulcer was that the lesion was superficial or nearly healed (18 cases). Other causes were small size, bleeding, swollen edges partly obliterating the crater, antral location, pylorospasm, cardiac location, and antral spasm. In 10 cases no apparent reason for failure was found.

The reasons for failure of gastroscopy were location of the ulcer in a "blind area," edematous folds or gastritis obscuring the lesion, hemorrhage, hypertrophic nodules mistakenly called diverticula, and probable healing of small ulcers in the interval after x-ray examination.

It is concluded that both examinations should be done in the presence of gastric symptoms, since the combination gives a much more accurate diagnosis than either alone.

Eight tables. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Gastritis of the Fundus Simulating Cancer. Giovanni Sanquirico and Nicolò Minuto. Ann. di radiol. diag. **26**: 319–326, 1953. (In Italian)

The early diagnosis of tumors of the fundus of the stomach presents considerable difficulty. Early symptoms are few, and by the time dysphagia is present the tumor is already extensive.

The authors report the case of a 54-year-old man which was noteworthy in the following respects. The dysphagia resembled the reflex type described by Moutier and Nemours-Auguste (Arch. d. mal. de l'app. digestif. **37**: 137, 1948), which is completely different from the true mechanical type; the pain was such as to suggest cancer of the fundus, and there was considerable weight loss. The x-ray examination also suggested a neoplasm; the barium remained in the terminal portion of the esophagus for an abnormally long time, and large rounded opacities with sharp edges encroached upon the gas in the fundus. Surgery was not attempted because of the patient's general condition. He improved markedly, however, on a medical regime, and roentgen examination one month later showed a completely normal gastric fundus.

Two possible explanations are offered for the clinical and x-ray picture in this patient: edematous gastritis and pseudotumoral hypertrophic gastritis. The second is thought to be the correct one.

The following lessons are to be learned from the study of this case: (1) The symptoms which have been attributed to cancer of the fundus are not pathognomonic, but are the expression of a localized lesion which might have repercussions at some distance, with esophageal and cardiac disturbances. (2) Once attention has been directed to the fundus, it is necessary to use all available technics in the study of this region, such as insufflation with stratigraphy to demonstrate the pliability of the fundal wall, realizing that in certain cases the diagnosis will still be impossible. (3) The "evolutive test," with the patient under strict control for as brief a period as is necessary, may clarify the nature of the disease.

Three roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Gastric Neurilemoma. Milton Dorfman. Gastroenterology **25**: 56–66, September 1953.

A case report of gastric neurilemmoma is presented and some ideas regarding the histogenesis of this type of neoplasm are briefly reviewed. Among the many names by which the tumor has been called are perineu-

rial fibroblastoma, schwannoma, neurinoma, and peripheral glioma.

The clinical features are variable, but hemorrhage is the most frequent symptom, as is usually the case in benign gastric tumors. Radiographically the mass in the author's patient was seen in the gastric fundus and ulceration was demonstrated. A positive differentiation from other benign gastric tumors is believed to be practically impossible. Treatment is surgical.

Two roentgenograms; 3 photographs; 2 photomicrographs. RICHARD A. ELMER, M.D.
Atlanta, Ga.

The Lymphatic Spread of Gastric Cancer. Douglas A. Sunderland, Gordon McNeer, Louis G. Ortega, and Leroy S. Pearce. Cancer **6**: 987–996, September 1953.

This is a preliminary report dealing with the study of 41 surgical cases of carcinoma of the stomach in which the entire stomach, lesser and greater omentum, body and tail of the pancreas, and the spleen were removed. In all cases a cuff of terminal esophagus was included, and in all but two cases a cuff of duodenum. Following this the specimen was dehydrated and cleared in dioxane. The lymph nodes were then dissected out, their size and location were diagrammed, and microscopic studies were done.

The dissected nodes fell into 6 zones. In Zone I were the paracardial lymph nodes, in Zone II the superior gastric, in Zone III the subpyloric, in Zone IV the inferior gastric, and in Zones V and VI the pancreaticolienal nodes. In 85 per cent of the specimens there were metastases to the lymph nodes.

The authors found that metastasis from cancers of the proximal segment of the stomach was chiefly to the superior gastric, paracardial, and pancreaticolienal lymph nodes. From the distal segment metastasis was predominantly to the superior gastric, subpyloric, and inferior gastric nodes. Those cancers which arose in the middle segment, as well as those occupying most of the stomach, were found to have metastasized to lymph nodes of all the zones with more equal regularity.

A high incidence of pancreaticolienal lymph node metastases was found. This group of nodes was involved in 51 per cent of the entire series and in 81 per cent of all cancers in the proximal segment that had metastasized at all. The authors felt that metastasis to these lymph nodes was not significantly influenced by gross adhesion of the stomach to the pancreas nor by direct invasion of the pancreas by the carcinoma.

The authors' study indicated that, when the cancer arose in the proximal or middle segment of the stomach, more lymph node metastases were present. Nodal involvement was most extensive when the stomach was entirely involved. Involvement was less in cancer of the gastric antrum.

Eleven drawings. RICHARD E. OTTOMAN, M.D.
Los Angeles, Calif.

Parapyloric Lymphadenitis. K. H. Barrakling. Fortschr. a. d. Geb. d. Röntgenstrahlen **79**: 315–318, September 1953. (In German)

During routine upper gastrointestinal x-ray examination with a contrast medium, a localized displacement of the barium is occasionally seen in the prepyloric region of the stomach or in the duodenum. It may be noticeable without compression, or compression may be required for its demonstration. It may be due to polypi within the gut, food remnants, foreign bodies, etc., or to extra-alimentary tumors causing pressure upon the bowel. Perhaps not enough attention has been paid to the fact that parapyloric enlarged lymph nodes may produce a similar picture.

In the winter of 1947–48, in a small town in Germany, within a short period of time, 5 patients were admitted to the local hospital with acute upper abdominal symptoms. The severe epigastric pain, with definite muscular resistance, slight elevation of temperature, and vomiting suggested a perforated peptic ulcer, but on operation no perforation was found. However, enlarged, inflamed lymph nodes were observed in the region of the antrum and the duodenal cap. The final diagnosis was an acute ulcerative gastritis with involvement of the parapyloric lymph nodes. In the course of a few weeks, all cases cleared up and symptoms disappeared. No x-ray examination was done before the operation.

The author, alerted by the report of these 5 cases, describes 4 cases of his own in which he could demonstrate defects in barium filling upon compression in the prepyloric area of the stomach and in the first part of the duodenum. In 3 instances the diagnosis of gastritis had been previously established. The fourth case was one of pancreatitis in which the presence of a parapyloric lymphadenitis was confirmed by operation. (The lymph vessels of the head of the pancreas also drain into the parapyloric lymph nodes.)

In cases of carcinoma of the stomach the changes in the appearance of the barium shadow due to pressure of the parapyloric lymph nodes cannot be demonstrated, probably because the wall of the antral portion of the stomach is rigid as a result of the tumor and will not permit the demonstration of barium displacement by manual compression.

In conclusion, the author suggests that in every acute inflammatory upper abdominal condition, an enlargement of the parapyloric lymph nodes should be considered, and it should be kept in mind that displacement of the barium on slight compression in the region of the pylorus may be due to this cause.

Three roentgenograms.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Extensive Prolapse of Gastric Mucosa. A Case Report Illustrating Difficulty in Diagnosis. Grayton Brown. Brit. J. Surg. **41**: 206–208, September 1953.

A 25-year-old unmarried woman suffered attacks of acute upper abdominal pain and gallstones were demonstrated radiologically. The gallbladder was removed in 1943 but the attacks of abdominal pain continued, and in 1947 the patient was further explored for a stone in the common duct. None was found. Some mesenteric cysts in the sigmoid mesocolon were removed and the common duct was drained. The drainage tube was accidentally dislodged four days later, resulting in choleperitoneum, and reopening of the incision with drainage was necessary. Complications and persistent vomiting required four further operations, including gastro-enterostomy, during the following weeks. In May 1952, an eighth exploration revealed a large tongue of gastric mucosa prolapsed through the pylorus. Gastrogastrostomy was done, following which the patient gained weight and was completely free from pain.

The case is presented because of the unusual condi-

tion found at the last operation and the various complications that developed in the attempts at its discovery.

Three drawings; one photograph.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Duodenal Obstruction in Infants and Children. Paul F. Fox. Arch. Surg. **67:** 475–488, September 1953.

Duodenal obstruction in infants and children is almost always the result of congenital maldevelopment. Intrinsic obstruction is usually due to atresia and is complete, though incomplete intrinsic obstruction as a result of stenosis may occur. Extrinsic obstruction as a rule is incomplete and is frequently accompanied by malrotation of colon, midgut volvulus, or both.

The author reports on 21 cases of duodenal obstruction in which operation was performed in a seven-year period (1946–53). Sixteen of the patients were twelve days of age or younger. Three were premature infants.

Roentgenographic examination in patients with atresia showed two fluid-air pockets, one in the dilated stomach and one in the dilated duodenum, with no air shadows distally. In partial obstruction the stomach and duodenum were in some instances dilated, but the diagnosis was usually established by demonstration of the narrowed area in the duodenum, and by delayed gastric emptying. A thin barium mixture or iodized oil was used for this purpose. Barium enemas often revealed malrotation of the colon.

The cause of the obstruction in 7 patients was duodenal atresia. In 12 patients partial obstruction was due to adhesive bands crossing the duodenum. One patient had a stricture of the duodenum, and one had a membrane partially occluding the lumen.

The author discusses the operative procedures and the results obtained. Of the 7 deaths in the series, 6 occurred in patients with atresia and 1 in a case of incomplete obstruction.

Three roentgenograms; 2 tables.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Compression of the Duodenum by the Superior Mesenteric Artery. Margaret Shumway, Walter M. Uhler, and Perk Lee Davis. Pennsylvania M. J. **56:** 816–817, September 1953.

A single case of duodenal obstruction due to compression by the superior mesenteric artery is presented, with the comment that this "exemplifies a normal anatomical cause for duodenal obstruction and gastric retention known to some but not all radiologists and very few diagnosticians." Upper abdominal pain, distention, and borborygmus are the usual symptoms. In the case reported, roentgenograms showed gastric and duodenal retention after six hours. The condition is relieved by change in position and lavage or, more permanently, by weight gain.

One roentgenogram.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Symptomatology of Small Intestinal Intussusception, on the Basis of One Case of a Malignant Carcinoid of the Jejunum. H. Garbsch and G. Hienert. Radiol. clin. **22:** 413–420, September 1953. (In German)

Tumors of the small intestine are rare. According to Ewing, only 3 per cent of gastrointestinal tumors are found in the small bowel. Swenson says that in about half the cases the mass caused by the enteric intussusception can be palpated, and its lack of fixation and changeability of position are fairly characteristic.

The authors report a case in a 47-year-old female who complained of colicky pain in the upper abdomen starting shortly after intake of food, spreading over the entire abdomen, and lasting two to three hours. The pain was occasionally accompanied by nausea and vomiting, and there was a history, also, of constipation alternating with diarrhea and of weight loss. X-ray examination showed a delay in the passage of barium from a hypotonic stomach into the small intestine; the proximal segment of the latter was widened and displaced, and Kerkring's folds were markedly accentuated. At the very distal end of this segment was a filling defect, and a tumor-like resistance, the size of an apple, was palpable. Spot films disclosed a "sleeve-type" widening of the barium column with a coiled-spring pattern of barium lining the intestine. An incomplete stenosis of the mid-segment of the jejunum due to an intussusception caused by a tumor was suspected. After a subsequent attempt at re-examination by means of barium introduced through a Miller-Abbott tube, the patient was operated on and a superficially ulcerating malignant carcinoid producing an intussusception about 1 meter from the ligament of Treitz was discovered.

The authors discuss the differential diagnosis and general pathology of these tumors. They state that the direct roentgen visualization of tumors in the small intestine is difficult, and in the majority of cases the developing stenosis leads to an indirect diagnosis. The criteria for direct recognition of a tumor are the same here as in the remaining gastrointestinal tract. The indirect criteria are: reflex retention of food in the stomach, marked widening of the prestenotic segment of bowel with gas and fluid levels, a coiled-spring or pincer effect, increased peristalsis, a crowding of Kerkring's folds with eventual obliteration.

Carcinoids occur mainly in the ileum (70 per cent) but also in the appendix and cecum. According to different authorities about 20 to 25 per cent of carcinoids in the ileum become malignant.

The authors state that in a pure enteric intussusception the following differential diagnostic points can be observed: a sleeve-like interposition of contrast medium between the intussuscipiens and intussusceptum, increase in the striations of the intussuscipiens, mobility of the invaginated tumor (inconstancy of localization) on palpation. A changing pattern indicates an intermittent form of intussusception.

In their discussion the authors point out that in their case a fairly exact diagnosis was made. In the so-called intermittent ileus a small intestinal examination can be safely performed and a diagnosis may sometimes be established. This can be done either by ingestion of barium, a small bowel enema, or through the use of a Miller-Abbott tube.

Two roentgenograms; 2 photographs.

JULIAN O. SALIK, M.D.
Baltimore, Md.

Some Radiological Aspects of Cancer of the Colon. Arthur C. Singleton. J. Canad. A. Radiologists **4:** 49–60, September 1953.

The author states that the radiologist cannot assume

responsibility for the diagnosis of rectal lesions, though radiological evidence is often of value in determining the limits of the disease and in planning surgical treatment. Both the rectum and lower sigmoid are frequently difficult to visualize satisfactorily. Because of the high incidence of polyps and carcinoma in these regions, adequate investigation requires both sigmoidoscopic and radiological examination. Hemorrhoids should not be accepted as the explanation of rectal bleeding until complete study has excluded more serious causes.

Methods of examination of the colon are briefly reviewed and the importance of adequate preparation is stressed. Some ways in which the radiological examination may be improved, as by use of special barium mixtures, overpenetration of films, and improvement in apparatus are mentioned.

The following simple classification of polyps is suggested: (1) single or few in number, (2) multiple polyposis, (3) pseudopolypi.

The isolated polyp is a common cause of rectal bleeding. While in the majority of cases it is benign, the possibility of eventual malignant change is a real one. Methods of examination of the colon must therefore continue to improve in an effort to discover a higher percentage of these small lesions. At present few lesions under 1 cm. are likely to be shown.

In multiple polyposis the whole colon is studded with small or medium sized polypi, which tend to show uniformity in size. A heredo-familial tendency is apparent, and the incidence of carcinoma is high.

The formation of pseudopolypi is seen in chronic ulcerative colitis, where islands of epithelial mucosa are pinched up by scar tissue. That this is a precancerous lesion is now widely believed, but whether the cancer originates directly in the chronic inflammatory mucosa, in the pseudopolypi, or in true adenomas which have developed in the pseudopolypoid mucosa is uncertain. Carcinoma associated with ulcerative colitis is likely to be highly malignant, with early metastases, and reported cures are rare.

The large bowel is not infrequently the site of intramural extramucosal tumors, as lipoma, fibroma, and myoma. These on occasion may be impossible to differentiate from a mucosal polyp prior to microscopic section. Other lesions producing a globular or hemiglobular defect which can be confused with polypi and small polypoid cancers include hypertrophy or prolapse of the ileocecal valve, inverted appendiceal stump, mucocele of the appendix, carcinoid, and impacted or fixed fecalith. Their differential diagnosis is discussed.

Ten brief case reports illustrating some of these conditions are presented.

Fifteen roentgenograms; 2 photographs of pathological specimens.

C. M. GREENWALD, M.D.
Cleveland Clinic

A Case of Multiple Calculi in the Large Intestine with a Review of the Subject of Intestinal Calculi. David Harland. Brit. J. Surg. **41**: 209–211, September 1953.

A male patient of 42 years gave a history of attacks of lower abdominal pain and constipation for over twenty years. About ten years after the onset, laparotomy was performed. A grossly enlarged colon was found, and a diagnosis of megacolon considered. The colon was partly excised and a temporary left iliac colostomy was made, which was later closed. Abnormal bowel function persisted thereafter, with diarrhea and abdominal discomfort.

Upon investigation, the abdomen was found to be markedly distended. Blood chemistry was within normal limits. A roentgenogram showed gross dilatation and distention of the colon. A large number of calculi were seen throughout the abdomen, but mainly in the descending colon. A barium enema showed a stricture in the lower sigmoid, probably at the site of the previous colostomy.

Operation revealed a megacolon from the sigmoid stricture to the ascending colon, not including the cecum. Colectomy was performed, and from the operative specimen 166 enteroliths were recovered. Analysis of the stones showed them to be composed of alternate layers of inspissated fecal material and mineral matter. Their formation is attributed to the stasis caused by the stricture.

True intestinal calculi are rare and only a small number of cases have been recorded in the literature, mostly in the small intestine. The author feels that the same factors apply to the formation of intestinal calculi as to calculi in the renal and biliary tracts. These are generally accepted as chemical and mechanical. The chemical conditions include infection, altered metabolism, and change in hydrogen-ion concentration; the mechanical factors are those producing stasis, *i.e.*, obstruction and diverticula and the presence of preformed nuclei.

One roentgenogram; 1 photograph.

FRANK T. MORAN, M.D.
Auburn, N. Y.

Gastrojejunocolic Fistula. A. G. R. Lowdon. Brit. J. Surg. **41**: 113–128, September 1953.

A discussion of the findings in 41 cases of gastrojejunocolic fistula is presented. Four of these patients had recurrence of fistula after operation and one had a second recurrence, making a total of 46 separate fistulas.

The communication of stomach, jejunum, and colon through a fistulous tract from a primary disease is a surgical curiosity. One was seen by the author complicating a case of carcinoma of the transverse colon, and one has been reported in a case of ulcerative colitis (Bargen *et al.*: Proc. Staff Meet., Mayo Clin. **12**: 385, 1937). For the most part, however, gastrojejunocolic fistula occurs only as a complication of gastrojejunal ulcer, when the abnormal communication between the stomach and jejunum has been made by a previous operation. The original anastomosis is usually done for duodenal ulcer, rarely for gastric ulcer.

The complication may occur after any type of gastrojejunal anastomosis, but in the majority of cases follows retrocolic gastroenterostomy. Of the fistulas comprising the author's series, 39 were associated with posterior gastroenterostomy, 2 with anterior gastroenterostomy, 1 with Devine's pyloric exclusion operation, and 4 cases with partial gastrectomy (2 retrocolic and 2 antecolic anastomoses).

The interval between the previous operation and onset of symptoms is variable, from one month to twenty-one years in the present series. The condition is strikingly rare in women.

There is a triad of symptoms which is almost conclusive evidence of the condition. These are diarrhea, fecal vomiting, and wasting, but rarely these symptoms are absent.

The physical condition of the patient varies greatly

with the duration and severity of symptoms. In the series reported, only 5 patients were in good condition when admitted to the hospital. Emaciation and dehydration were commonly observed, and laboratory studies showed a disturbance of electrolyte balance.

Barium enema is the preferred means of investigation and is more likely to demonstrate the lesion than a barium meal. In only 8 of 22 patients in the reported series given a barium meal was a fistula demonstrated, while among 32 cases investigated by barium enema, the fistula was found in 31. In the single case in which the fistula was not demonstrated by the latter means, the opaque medium had failed to pass the splenic flexure.

The treatment of gastrojejunocolic fistula is surgical. If the condition of the patient is good, excision of the fistula and partial gastrectomy can be done. Most cases, however, will require a proximal transverse colostomy followed in two or three months by definitive operation, including resection of at least four-fifths of the stomach, with closure of the colostomy two or three weeks later.

Three roentgenograms; 2 photographs; 6 photomicrographs; 5 tables. FRANK T. MORAN, M.D.
Auburn, N. Y.

A Special Radiologic Sign of Meckel's Diverticulum. Carlo Zuber. Arch. radiol. **28:** 451–458, 1953. (In Italian)

Normally a Meckel's diverticulum is asymptomatic. Certain abnormalities, however, may be productive of a clinical syndrome. These include (1) mechanical obstruction and torsion due to the persistent cord between the diverticulum and abdominal wall, with or without cyst formation; (2) the presence of ectopic pancreatic or gastric epithelium, with ulceration; (3) lack of normal innervation, causing diminished motility with impairment or absence of peristalsis, which in turn makes emptying difficult and may lead to abdominal pain.

Usually these patients are not subjected to extensive radiologic examination because of the acuteness of the clinical picture. In the case described by the author, in a 26-year-old male, actual visualization of the gas-filled diverticulum was obtained in a gastrointestinal series, while examination repeated after forty-eight hours showed the same area filled with barium. The fact that the diverticulum was closed to the barium one day and open the next may have been due to a papilloma found at its neck. This too might explain the intermittency of the pain. The terminal loop of the ileum from which the diverticulum arose was dyskinetic and dilated.

While the finding of the diverticulum in this case is to be considered fortuitous, it is hoped that radiologists will be stimulated to search for such minimal signs suggesting the presence of a Meckel's diverticulum. While gastrointestinal hemorrhage in some 90 per cent of the cases is referable to a duodenal ulcer, the possibility of a Meckel's diverticulum should be considered, especially in children.

The author cites a case reported by Lerner *et al.* in which an air-filled Meckel's diverticulum was demonstrated on the plain abdominal film (Am. J. Roentgenol. **69:** 268, 1953. Abst. in Radiology **61:** 969, 1953).

Two roentgenograms; 1 photograph.
CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Cholecystitis Glandularis and Diverticula of the Gall-Bladder. E. S. J. King. Brit. J. Surg. **41:** 156–161, September 1953.

Although various terms, including Rokitansky-Aschoff sinuses, Luschka's sinuses and glands, and diverticula, have been applied to a specific condition of the gallbladder, the author prefers cholecystitis glandularis. The condition is one in which epithelium-lined spaces in the form of sinuses or glands are found in the gallbladder wall. The changes are morphological but usually with corresponding functional disturbances. Poor concentration of the contrast medium by the diseased gallbladder is probably the reason for the infrequency of diagnosis by x-ray study. When visualized, the periphery of the organ shows well defined crypts, with alternate areas of filling and non-filling, with or without stones. The gallbladder may be unilocular or bilocular.

Two cases of cholecystitis glandularis diagnosed by cholecystography are presented. One was unilocular containing mixed calculi and the other bilocular containing translucent calculi.

The author discusses at some length his preference for the designation cholecystitis glandularis and the need for clearing up the present confusion in terminology.

Two roentgenograms; 2 photographs; 4 photomicrographs. FRANK T. MORAN, M.D.
Auburn, N. Y.

Cholangiography. Philip G. Keil, George J. Hegstrom, and Samuel J. Zoeckler. Ann. Int. Med. **39:** 479–483, September 1953.

Oral cholecystography is most reliable when the biliary system is normal and least reliable in the presence of disease. Visualization usually fails when the examination is most indicated, *i.e.*, in the differential diagnosis of intrahepatic and extrahepatic obstruction. The cystic and common ducts are rarely visualized sufficiently for diagnosis even when opacification of the gallbladder is optimal.

Cholangiography performed in the course of peritoneoscopy has been shown to be useful in diseases of the biliary tract defying diagnosis by other means (Keil and Landis: Arch. Int. Med. **88:** 36, 1951. Abst. in Radiology **58:** 773, 1952), and added experience has reaffirmed the value of this procedure.

The technic described in the earlier report has been slightly modified. After the gallbladder has been visualized peritoneoscopically, a 5-inch 20-gauge needle is inserted through the overlying abdominal wall and guided, under direct vision, to the area of the fundus, where it is inserted with a quick thrust through the gallbladder wall. After aspiration of 5 to 50 c.c. of bile, 10 to 15 c.c. of 35 per cent iodopyracet is injected and roentgenograms are obtained.

Fifty-five direct cholangiographic studies were performed during 787 peritoneoscopic examinations. Clinically it was not possible in these cases to differentiate between hepatocellular damage and extrahepatic biliary obstruction; liver function studies, if abnormal, were equivocal, and the gallbladder was not visualized adequately after oral cholecystography. Eighteen patients were found to have normal gallbladders and ducts, with cirrhosis of the liver (proved histologically). Ten had solitary non-opaque calculi or multiple small stones in the gallbladder and ducts. In 2 cases, retrograde filling of the stomach was noted, and in 1 a

communication was demonstrated between the fundus of the gallbladder and the colon. One patient had obstruction and dilatation of all ducts in association with carcinoma of the head of the pancreas. The remaining 24 examinations were performed upon patients with suspected biliary tract disease who proved to be normal, patients with metastatic carcinoma of the liver, and a variety of other pathologic states.

The use of lesser amounts of 35 per cent iodopyracet solution (as compared with earlier practice) has decreased considerably the abdominal discomfort experienced by the patient. In a few cases in which the medium was apparently retained for considerable periods, administration of nitroglycerin sublingually alleviated the spasm and permitted visualization of the ducts.

The gallbladder is visualized in nearly all routine peritoneoscopic examinations. Vision is precluded only by the presence of rather massive adhesions in the right upper quadrant, usually the result of prior surgical procedures in this area. The information obtained is equal to that with cholangiography performed at the time of laparotomy. The procedure is simple and often spares the patient the rigors of operation.

Seven roentgenograms.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Aortography and Tumors of the Liver. Preliminary Report. Bernardo Milanés, Jorge McCook, and Alfredo L. Hernández. Angiology **4**: 312–320, August 1953.

The authors employ translumbar aortography as a routine procedure in all patients with abdominal tumors. In the present paper they emphasize its value, particularly in the diagnosis of malignant tumors of the liver, primary or secondary, and report 4 illustrative cases.

The technic used is that of Dos Santos (Med. contemp. (Lisbon) **47**: 93, 1929; J. internat. chir. **2**: No. 6, 1937) as far as concerns the site of the puncture, the needle, the selection of the radiopaque medium, the injector apparatus, etc., save that once the needle is introduced, it is inclined upward as much as possible so that the injection of the medium can be made above or on a level with the origin of the celiac trunk. In normal cases with this method it is possible to demonstrate the trunk of the hepatic artery with its right and left terminal branches; the latter are visible, however, within a radius of not more than 5 or 6 cm., so that the finer branches terminating in the hepatic parenchyma remain unvisualized.

In 1 of the authors' cases aortography facilitated the diagnosis of a metastatic hepatic tumor not indicated clinically, and in 2 cases the aortographic diagnosis preceded that based on biopsy.

Six roentgenograms; 1 photograph.

Ruptured Hydatid Cyst of the Liver, with a Fistula Between the Hepatic Duct and the Cyst. Richard Flynn and Leo Flynn. M. J. Australia **2**: 497, Sept. 26, 1953.

The case of ruptured hydatid cyst of the liver reported here, with formation of a fistula communicating with the hepatic duct, is of interest because it was possible by means of a postoperative choledochogram, to demonstrate the site of the rupture.

Three roentgenograms.

THE MUSCULOSKELETAL SYSTEM

Multiple Myeloma (Including a Report of 11 Cases). Paul J. Parks. J. Kentucky M. A. **51**: 351–358, August 1953.

Multiple myeloma is a neoplasm of bone comprised of plasma cells arising directly from the reticular cells of the reticulo-endothelial or histocytic tissue. It is generally believed that it represents an abnormality of the reticulo-endothelial system in which abnormal numbers of plasma cells are formed from the reticulum without the mediation of the myeloid or lymphocytic series. It is sometimes known as plasma-cell myeloma, plasmocytoma, and plasma-cell leukemia. The disease is primarily one of adults, occurring most frequently between the ages of forty and seventy and very rarely before the age of thirty. It is twice as common in the male as in the female.

Pain in the areas of involvement is the outstanding symptom. Anemia is a frequent feature and, in association with bone pain in an elderly individual, should suggest the diagnosis. Both the red blood count and the hemoglobin are reduced, and the anemia becomes more severe as the disease progresses. This is probably due to replacement of normal marrow by myeloma cells.

Rouleaux formation is a common finding, apparently dependent upon hyperglobulinemia, and the serum globulin may reach high levels. The albumin may be normal, but is more frequently reduced. The total protein may be elevated or normal. Elevated serum calcium is a frequent finding and is apparently due to bone lysis. Since it is associated with normal serum phosphorus, it is a differentiating point from hyperparathyroidism. The alkaline phosphatase level is usually normal or slightly elevated.

Multiple discrete osteolytic lesions in the skeleton of an adult man are presumptive evidence of multiple myeloma. Multiple myeloma affects red marrow, and the early lesions are therefore found in the ribs, sternum, spine, clavicles, skull, and proximal portions of the extremities, in about that order of frequency. Since the tumors are destructive of bone, they are frequently seen roentgenographically as rounded punched-out areas, varying in size from a pea to an orange. They may be so widespread as to produce a mottled appearance. Sometimes the changes are so severe that the general impression is one of diffuse osteoporosis. Pathological fractures may occur. At times, only a single lesion is demonstrated, and the diagnosis of a solitary myeloma may be made. However, generalized bone marrow infiltration and widespread bone destruction usually develop.

A diagnosis of multiple myeloma should never be made without confirmation by bone marrow aspiration or bone biopsy. The procedure is diagnostic in about 90 per cent of the cases at some time during the course of the disease.

Nephritis and amyloidosis are frequent complications. The renal lesions are limited to the tubules and interstitial tissues and the glomeruli are not involved.

There is no specific treatment for multiple myeloma, and the course is usually progressive, with death in an average of two years, although some patients have lived as long as nine years. X-ray therapy is one of the earlier forms of treatment and continues to be most helpful, particularly in relieving pain. Regato feels that myeloma lesions are very radiosensitive and locally

radiocurable, and that treatment of multiple new lesions may increase life expectancy. He believes that, in order to obtain local sterilization, treatment should be continued long after the clinical disappearance of the tumor.

ALFRED O. MILLER, M.D.
Louisville, Ky.

Osteopathy from Hyperthyroidism. Roberto Ghislanzoni. Arch. radiol. **28:** 416–428, 1953. (In Italian)

According to Albright, all the hormonal bony osteopathies can be put into a single pathogenetic scheme, so far as the several endocrinopathies evoke changes in protein metabolism which give origin to the osteopathy itself. The processes of protein synthesis are regulated by the hypophysis, sex hormones, and the "N" hormone of the adrenal cortex. The transformation of protein into carbohydrate is regulated by the "S" principle of the adrenal cortex, and the processes of protein degradation associated with energy expenditures are under the control of the thyroid hormone. The thyroid hormone, therefore, is principally catabolic. It evokes and increases combustion, and, when present in excess, leads to a negative protein balance. A direct consequence of this is an alteration in the protein matrix of the bone, which, being of poor quality, "fixes" incompletely the calcium and phosphorus, and from this imperfect "fixation" the osteoporosis of hyperthyroidism has its origin. The theory of Leriche, according to which the hyperemia of hyperthyroidism causes hyperactivity of the parathyroids, which in turn is responsible for the bony changes, is not acceptable, since the blood chemistry does not support a hyperparathyroidism.

Estimates of the incidence of radiologically discernible osteoporosis in hyperthyroidism range from 20 to 50 per cent. The author describes in detail the clinical and radiologic findings in a case of hyperthyroidism in a 68-year-old woman. The bones showed a generalized osteoporosis of homogeneous type, with attenuation to complete disappearance of the cortex and trabeculae. In the differential diagnosis, the osteomalacias were not considered, since these are usually easily recognized. Senile osteoporosis was excluded because of its predilection for the vertebral column, pelvis, and proximal metaphyses of the femora, usually sparing the diaphyses of the femora and other long bones, which in the present case were chiefly involved. Furthermore, the senile variety predominantly involves the iliac wings, without affecting the spongiosa of the pectineal zone and sacrum; exactly the opposite condition prevailed in the author's patient.

A complete differential diagnosis is not possible without the aid of clinical and laboratory data. The blood calcium and phosphorus are normal in this type of osteopathy, and the urinary and fecal excretion of calcium is increased.

Eleven roentgenograms.

CHRISTIAN V. CIMMINO, M.D.
Fredericksburg, Va.

Calcinosis: Report of Two Cases. Aires de Sousa and J. Paiva Chaves. J. Bone & Joint Surg. **35-B:** 423–425, August 1953.

Calcinosis is an anatomical, pathological, radiologic, and clinical entity in which multiple deposits of calcium are laid down in the skin, subcutaneous tissues, and connecting structures of deeper tissues. It has never been demonstrated in the internal organs or viscera. It is to be distinguished from metastatic and dystrophic calcification, and from myositis ossificans. Two cases are here described.

The first patient was a 3-year-old girl with congenital dislocation of the right hip, discovered at two years of age. At that time roentgenograms showed no abnormal soft-tissue calcification. No treatment was given for the hip condition. Repeat roentgenograms at three years showed numerous areas of calcification, some rounded and some in the form of thick bars, grouped around the iliac bones and the proximal ends of both femurs. There were no calcific deposits elsewhere in the body. Operation for the hip dislocation was eventually performed at the age of four, and subsequent radiographic examination showed no progress of the calcium deposits.

The second case reported here is that of a 46-year-old man with calcinosis in both thighs, discovered incidentally in an examination undertaken because of pain in the spine and in the hips.

Four roentgenograms.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Primary Asymptomatic Calcification of Articular Cartilage. Report of a Case. D. A. W. Edwards and S. Davis. J. Bone & Joint Surg. **35-B:** 434–436, August 1953.

A 45-year-old male, complaining of pain, tenderness, and swelling of the right knee of two weeks duration, showed on roentgenographic examination mild osteoarthritic changes and rather extensive flocculent calcification in the semilunar cartilages and surfaces of the articular cartilages of both knees. The appearance was consistent with either calcification of the superficial layers of articular cartilage cells or incrustation of calcium-containing material upon a deeply fissured articular surface. Similar changes were found in both shoulders and the left wrist. Some of the joints involved had never been painful. No histologic examination was made and the exact nature of the deposit was not proved.

Three roentgenograms.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Familial Hyperplastic Callus Formation. Case Followed for Twenty Years. Gwen Hilton. J. Bone & Joint Surg. **35-B:** 411–416, August 1953.

The case reported is that of a girl first observed at the age of ten with bilateral swellings of the thighs. These were tender and were associated with fever. Roentgenograms showed masses of irregular ossification adjacent to the femurs but no evidence of fracture. A further skeletal survey disclosed hyperostotic ridges on both humeri, the forearm bones, the left fibula, and several metacarpals and metatarsals. Biopsy of the mass adjacent to the left femur showed very cellular chondroid and chondro-osteoid tissue. Roentgen therapy was followed by subsidence of pain and tenderness, though it is pointed out that similar results have occurred in other cases without irradiation.

The patient's mother and one maternal aunt were found to have hyperostotic ridging of several bones. A second maternal aunt had changes similar to those shown by the patient but more pronounced.

During the twenty-year period in which this patient was followed, numerous episodes of painful swellings occurred in relation to the bone cortex in many locations and accompanied by radiographic changes.

The characteristics of familial hyperplastic callus formation as described by Fairbank (Fairbank and Baker: Brit. J. Surg. **36:** 1, 1948. Abst. in Radiology **53:** 456, 1949) are: (1) formation of large masses of heavily calcified local callus adjacent to bone affected; (2) absence sometimes of clinically recognizable fractures; (3) a tendency of the callus to be permanent and become incorporated into structure of affected bone; (4) formation of bony excrescences and hyperostotic ridges on shafts of bones; (5) stunting and bone deformities, especially bilateral dislocation of the radial heads; (6) features suggestive of osteogenesis imperfecta.

The condition differs from osteogenesis imperfecta in that there may be no history of multiple fractures and in the tendency of the excessive callus to persist instead of being absorbed.

It is important to recognize this condition since the clinical and roentgenologic findings may suggest a malignant bone tumor. Even the histologic appearance of the highly cellular and rapidly growing callus may be mistakenly considered malignant. Recognition of the true nature of the process will forestall unnecessary amputations.

Seven roentgenograms; 1 photomicrograph; 1 photograph.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Hyperplastic Callus Formation in Osteogenesis Imperfecta. Report of a Case and Review of the Literature. E. H. Strach. J. Bone & Joint Surg. **35-B:** 417–422, August 1953.

An 11-year-old girl gave a history of multiple fractures beginning shortly after birth. Spontaneous swelling of the right thigh appeared at nine years of age and roentgenograms showed bony excrescences over both the thigh and the bones of the forearms. At ten years of age a mild injury to the left thigh was followed by swelling and subsequent new bone formation. Histologically this was shown to be hyperplastic callus. Later new foci of callus developed without apparent cause. Treatment by ACTH had no effect, but roentgen irradiation in single doses of 500 r to individual deposits appeared to arrest the process. Fever and pain accompanied the developing period of the callus. The blood chemistry was normal except for high serum alkaline phosphatase.

A review of the literature is presented, with a brief summary of the findings in the 15 reported cases.

Eight roentgenograms; 1 photograph; 1 graph.

RICHARD P. STORRS, M.D.
SYRACUSE, N. Y.

Neuropathic (Charcot) Joints Occurring in Diabetes Mellitus. W. M. Sheppe. Ann. Int. Med. **39:** 625–629, September 1953.

The occurrence of gross changes in the bones of the feet as a complication of diabetes mellitus has been described. The lesion usually develops insidiously and during periods of uncontrolled diabetes. The signs and symptoms of a diabetic neuritis are usually prominent, while the circulatory status of the extremity may be unimpaired. Perforating ulcers without gross infection or gangrene are often noted. The involved foot is swollen but painless, even when bearing weight. On x-ray examination the characteristic appearance is fragmentation and lysis of the bones of the foot, especially the tarsal bones and proximal ends of the metatarsals. Callus formation is noticeably absent.

The author's patient, a 58-year-old female with diabetes diagnosed seventeen years earlier, showed marked changes in the right foot. Destruction was noted at the head of the first and second metatarsals and at the base of the proximal phalanx of the big toe and the second toe. The third toe was dislocated, with some slight destructive changes at the base of the proximal phalanx. Especially at the big toe, small bony fragments were noted inside the area of bone destruction, between the fragments of the uninvolved bone. These findings were considered suggestive of Charcot's disease of the right foot.

The clinical and roentgenologic characteristics of this case are closely comparable to those previously described. Bone destruction was relatively slight in the tarsus but marked in the first three metatarsals and the proximal phalanges. The foot exhibited no sign of cellulitis or other infection, and no pain was present. The other clinical entities (syphilis, syringomyelia, and leprosy) known to produce joints of the Charcot type were easily excluded.

Four roentgenograms.

STEPHEN N. TAGER, M.D.
Evansville, Ind.

Osseous Changes in Neural Leprosy. James Barnetson. South African M. J. **27:** 827–828, Sept. 19, 1953.

The author's findings are based on a roentgen study of a large series of Africans with neural leprosy, supplemented in a few instances by histologic examination of the bones. Atrophy is considered to be the basic osseous lesion of neural leprosy. Changes begin in the distal margins of the terminal phalanges of the fingers and toes. As the atrophy extends proximally, the tuft, shaft, and finally the base of the phalanx become absorbed, with the process continuing in the distal part of the middle phalanx. There is no periosteal reaction, osteosclerosis, or sequestration in the absence of secondary infection. Changes are nearly always bilateral, but rarely symmetrical.

Secondary osseous changes are common and can usually be related to fairly obvious factors. In the foot, there is extensive resorption about the metatarsal phalangeal joints, which bear the brunt of weight bearing. Similar changes occur in the hand when flexion deformities are present. Concentric atrophy with gradual narrowing of the shaft of the metatarsals, metacarpals, and proximal phalanges is fairly common. Diffuse osteoporosis is uncommon, and pathological fractures are rare.

Histologic examination revealed little evidence of osteoclastic resorption, its absence being difficult to explain except on the grounds of the extreme slowness and chronicity of the process. The three essential features of neural leprosy, bone absorption, failure of reflex vasomotor response, and extent of anesthesia, were in accord to a significant degree.

It is suggested that the failure of reflex vasomotor response, due to destruction of vasomotor fibers by the leprous peripheral neuritis, is of fundamental importance in the causation of the osseous change.

C. M. GREENWALD, M.D.
Cleveland Clinic

Clinico-radiological Manifestations of Alkaptonuria. Guillermo García López and J. Manuel Viamonte with collaboration of Lino Boudet. Rev. mex. de radiol. **7:** 247–254, May-June 1953. (In Spanish)

A male office worker, age 46, complained of joint pains for six years, of rigidity of the spine for two years, and more recently of limitation of motion of the hips and pain in the knees. His urine turned black on standing and caused dark stains on his clothing. Examination revealed dorsal kyphosis and exaggeration of the cervical and lumbar curves, rigidity of the spine, and stiffness of the hips and right knee, with crepitus. The patient walked slowly. There was dark pigmentation of both sclerae and of the cartilages of the ears. The urine was positive for homogentisic acid.

X-ray examination revealed calcification of intervertebral disks, marked osteoarthritis of the right shoulder, and radiolucent areas in the right humeral head corresponding to deposits of homogentisic acid. There was internal derangement of both knees, with presence of loose bodies.

Two sisters showed similar symptoms and signs.

Twenty-one roentgenograms. E. KRAFT, M.D.
Newington, Conn.

Sickle-Cell Anemia with Unusual Bone Changes. Robert E. Ivy and Fred H. Howard. J. Pediat. **43:** 312–315, September 1953.

A case is presented of a one-year-old child with sickle-cell anemia and severe bone changes in the wrists and hands, demonstrated roentgenographically.

Areas of radiolucency, both subperiosteal and intramedullary, were apparent in the distal metaphyses of the radius and ulna, as well as in the metacarpals and phalanges. There was evidence of expansion of the bone, but no signs of new bone formation were found. Roentgenograms of the other long bones, chest, skull, and feet were within normal limits. After about three months the bones appeared to be completely normal.

Two roentgenograms; 2 photographs.

HOWARD L. STEINBACH, M.D.
University of California

A Case of Infantile Cortical Hyperostosis Affecting Only the Clavicle and Scapula. Jon Walley. J. Bone & Joint Surg. **35-B:** 426–431, August 1953.

A male infant with no previous illness was found at two months of age to have a tender swelling over the right clavicle and to show a tendency to immobilize the right arm. He had a low-grade fever. The skin was pink and slightly warm over the clavicle, which was shown roentgenographically to be encased in new periosteal bone throughout its length. Penicillin was given intramuscularly for three weeks. As the clinical signs subsided, the clavicle seemed smaller but swelling was felt over the right scapula and roentgenographic examination showed marked thickening of the bone. Five months after the onset, both the clavicle and scapula were nearly normal in appearance, and the child used the right arm normally.

This case was originally considered to be one of acute osteomyelitis but the later progress was indicative of a process of the type described by Caffey and Silverman as infantile cortical hyperostosis (Am. J. Roentgenol. **54:** 1, 1945. Abst. in Radiology **46:** 538, 1946). The absence of any clinical or radiologic evidence of involvement of the mandible is unusual.

An appendix summarizes the findings in 43 previously reported cases of this syndrome.

Six roentgenograms; one table.

RICHARD P. STORRS, M.D.
Syracuse, N. Y.

Technic of Radiologic Examination of the Sternum. M. Benmussa. J. radiol. et électrol. **34:** 646–648, 1953. (In French)

The technical difficulties in radiologic examination of the sternum are well known. In this paper technics are described for examining the sternum as a whole and the manubrium separately. For the first, the patient is prone on the examination table, with a sandbag placed under the chest. Above this a malleable piece of lead is placed, and above this a flexible film, directly against the sternum. The x-ray tube is centered between the medial margin of the right scapula and the spine and is directed toward the sternum. The tube is then drawn down until it is 1 or 2 cm. from the skin of the back. The patient breathes quietly during the procedure. The technical factors are: 40 to 50 kv., 30 to 50 ma., three and one-half to five seconds. The effects of normal respiration and the distance factor cause a blurring of most of the anatomic features except the sternum on the film. The reproduction shown in the paper is excellent.

A special view of the manubrium requires cessation of respiration, and the tube is moved craniad to be centered directly over the manubrium. A roentgenogram obtained with these procedures is also reproduced.

CHARLES NICE, M.D.
University of Minnesota

Vascular Canals in the Bones of the Wrist. A. Ravelli. Radiol. clin. **22:** 461–465, September 1953. (In German)

Round radiolucent areas have been demonstrated roentgenographically in the bones of the wrist, especially in the dorso-volar projection, sometimes surrounded by a thin bony ring. The larger ones are often reported as cysts or thought to represent the result of localized hemorrhages. Actually, the majority of these radiolucent areas probably represent vascular canals, as has been demonstrated in the case of the capitate bone by filling with barium paste and subsequent roentgenography. Similar areas, some minute and others larger, are demonstrable in the hamate, multangular, navicular and lunate bones, and occasionally in the triquetrum.

The smaller shadows should not be confusing. The larger ones must be differentiated from cysts. This may be done by observation in different projections. The cyst will usually show no change in form.

Eight roentgenograms. JULIAN O. SALIK, M.D.
Baltimore, Md.

Vascular Channels in the Phalanges. A. Ravelli. Radiol. clin. **22:** 465–469, September 1953. (In German)

Occasionally one sees in dorsoventral views of the hands of children small, sharply delineated round or oval areas of radiolucency located in the middle phalanges or, in the case of the thumb, in the proximal phalanx. They are believed to represent nutrient canals, so-called *foramina nutricia* or *canales nutricii.*

Similar smaller punctate areas of radiolucency representing nutrient foramina are also observed in adults. They are rarely seen in the distal phalanges and except in the thumb have not been demonstrated in the proximal phalanges. The author describes the anatomical basis for these findings and cautions against confusing them with pathological changes.

Three roentgenograms; 1 drawing.

JULIAN O. SALIK M.D.
Baltimore, Md.

Diskography. Baudelio Villanueva and Manuel Sánchez Garibay. Rev. mex. de radiol. **7:** 192–196, March-April 1953. (In Spanish)

The authors describe the technic of injecting opaque material directly into the nucleus pulposus of the intervertebral disk, a procedure introduced by Lindblom (Acta radiol. **34:** 321, 1950. Abst. in Radiology **57:** 612, 1951). The method is supplementary to myelography and is indicated when more routine studies are inconclusive.

Contraindications are intolerance to the contrast medium and vertebral anomalies which make the insertion of a needle technically impossible. In selected cases the procedure is efficient. So far the findings have always proved correct on operation.

The authors have used diskography in a small series of cases which, however, they do not report in detail.

Eighteen roentgenograms.

E. KRAFT, M.D.
Newington, Conn.

Ruptured Intervertebral Disc. Report of a Case with a Defect in the Anterior Annulus Fibrosus. Milam E. Leavens and F. Keith Bradford. J. Neurosurg. **10:** 544–546, September 1953.

Two cases of vascular complications following disk surgery have been reported in the literature (Linton and White: Arch. Surg. **50:** 6, 1945; Holscher: J. Bone & Joint Surg. **30-A:** 968, 1948). The authors know of 12 other cases, most of which terminated in death as a result of injury to the great vessels anterior to the fifth lumbar vertebra or adjacent vertebrae.

The case reported here is one of rutpure of the intervertebral disk at L-5. At surgery, after removal of a loose piece of nucleus pulposus, a closed rongeur was placed in the annulus defect and was noted to pass readily into the interior of the disk and then, with minimal pressure, to fall farther through what was believed to be a fissure through the anterior annulus. The fissure was demonstrated by roentgenograms after injection of iodized oil. The authors postulate that such a defect in the annulus fibrosus may exist more often than has been realized and may explain some of the vascular injuries that have occurred despite care exercised during disk surgery.

Two roentgenograms.

HARRIET M. WISNIEWSKI, M.D.
Cleveland City Hospital

The Variety of Spinal Lesions Simulating the Disk Syndrome. Frank J. Otenasek. South. M. J. **46:** 843–846, September 1953.

The author illustrates by seven case reports the variety of spinal lesions which simulate the disk syndrome. A classic history, with all the physical and neurological findings of a disk lesion, including x-ray proof of degeneration, is not always sufficient to confirm the diagnosis. The possibility of dual lesions must always be kept in mind. The following findings render spinal studies, including myelography, imperative:

(1) Night pain, especially when unrelieved by lying down.

(2) Persistence of pain, without remission, from its initial onset.

(3) Root pain over a distribution higher than the fifth lumbar dermatome (for example, the anterior thigh).

(4) Alteration of the knee-kick.

(5) Signs of bladder involvement: incontinence or retention.

(6) Failure to obtain relief after removal of a disk lesion.

Six photomicrographs.

T. E. KEATS, M.D.
University of California

Osteitis Condensans Ilii. Joseph Bloom. J. Canad. A. Radiologists **4:** 61–65, September 1953.

The pathogenesis and etiology of osteitis condensans ilii are obscure. It is apparently a self-limited process not falling into the category of any known bone disease. The disease is largely, though not entirely, confined to white women of childbearing age. Most cases are asymptomatic. The process is reversible, and clearing of the lesion can occur.

The radiologic picture is characterized by dense bony sclerosis of the auricular portion of the ilium, with obliteration of the trabeculae, giving a somewhat "frosted" appearance. The sclerosis ends abruptly at the sacroiliac joint medially, and merges into normal iliac bone laterally. Sepia toning and overexposure of the film help to show the lesion to better advantage. The diagnosis necessitates exclusion of pathologic change within the sacroiliac joint and sacrum, as neither of these structures is ever involved in osteitis condensans ilii. This is best accomplished through oblique views of the region. Lesions to be differentiated include those of Marie-Strümpell arthritis, sacroiliac epiphysitis, Paget's disease, and degenerative arthritis.

In symptomatic cases, pain is usually chronic, occurring in the low back. It is never sciatic in distribution, and night pain is significantly absent. The roentgen appearance bears no relation to the severity of the symptoms. Although the condition frequently responds to conservative physiotherapeutic measures, an occasional case may require fusion of the sacroiliac joint. Reports of two severe cases are presented, in each of which good results were obtained from deep roentgen therapy (air dose of 1,600 r). The author believes irradiation should be tried before resort to surgery.

Ten roentgenograms.

C. M. GREENWALD, M.D.
Cleveland Clinic

The Normal Vascular Anatomy of the Femoral Head in Adult Man. J. Trueta and M. H. M. Harrison. J. Bone & Joint Surg. **35-B:** 442–461, August 1953.

This study of the vascular anatomy of the femoral head is based upon radiographic and microradiographic examinations of postmortem specimens injected with barium sulfate suspensions or 10 per cent colloidal silver iodide, supplemented by other technics.

Summarizing their observations, the authors state that it has been found possible to delimit the proximal femoral epiphysis in mature years by reference to ar-

terial form alone. Two morphologically different sets of vessels are described, interposed between the arterioles and venules of the bone marrow. One, a true capillary bed, lies mainly within the fat marrow; the other, constituted by sinusoids, lies within the red marrow. The departure of these findings from current views is noted. A capillary system is described in relationship to the calcified zone of the articular cartilage. No evidence was found in support of the common belief that the circulation within the femoral head decreases quantitatively with advancing age.

Thirty-one illustrations.

Effect of Chronic Fluorine Intoxication upon the Healing of Experimental Fractures in Rats. Richard T. Odell and J. Albert Key. Ann. Surg. **138:** 461–466, September 1953.

The authors studied the effect of a relatively small dose of fluorine upon the healing of experimental fractures in rats. The dosage was not sufficient to impair the health or inhibit the growth of the animals. Both young and adult rats were used. The animals were sacrificed at various intervals following the induction of the fractures (in the humeri), and the fractured bones were studied grossly, roentgenographically, and microscopically.

The observations showed that a proportion of 226 parts per million of sodium fluoride in the drinking water of rats does not inhibit the repair of fractures, and it is suggested that it may exert a slightly favorable influence on the process.

Eight roentgenograms; 5 photomicrographs.

T. E. KEATS, M.D.
University of California

GYNECOLOGY AND OBSTETRICS

Hysterosalpingography Studies Following Ectopic Pregnancy. Daniel G. Cook and John A. Butt. Am. J. Obst. & Gynec. **66:** 626–636, September 1953.

In a series of 70 operations for ectopic pregnancy, 14.3 per cent represented recurrent tubal pregnancy following earlier surgery.

Twenty-five patients were studied by salpingography after operation. The residual tube was found to be occluded in 9 cases. The two major causes of occlusion were cornual spasm and tubal disease which had progressed to severe hydrosalpinx. There were 3 cases of obstruction at the fimbriated end of the tube with frank hydrosalpinx. In only 1 case was the obstruction in the isthmic portion of the tube. There was no history of pelvic inflammatory disease in this instance, and none was noted at surgery. The occlusion was attributed to blood in the peritoneal cavity and its subsequent organization. Five of the occluded cases gave a history of pelvic inflammatory disease, which was confirmed at surgery. Perisalpingitis or hydrosalpinx was demonstrated in 4 of these 5 cases. One repeat ectopic pregnancy occurred in this group and the studies following the first tubal pregnancy showed mild dilatation of the distal third of the tube and moderate perisalpingitis. The second tubal pregnancy was found when the patient was operated on for a large simple cyst of the ovary.

Sixteen of the patients investigated were found to have patent residual tubes. In 4 cases the residual tubes were perfectly normal. In 9 cases there was perisalpingitis with kinking of the tube due to adhesions. There were 7 cases of hydrosalpinx. Two cases are reported in which salpingograms were obtained between ectopic pregnancies. One of these patients showed mild pelvic inflammatory disease following operation for a ruptured right tubal pregnancy. Subsequent salpingography failed to show the residual tube, due to severe cornual spasm. Patency was demonstrated by the Rubin test. Two years later this patient was operated on for a ruptured left tubal pregnancy.

Seven roentgenograms; 4 tables.

MASON WHITMORE, M.D.
Jefferson Medical College

Transabdominal Pneumoperitoneum as an Aid in the Diagnosis of Sex-Endocrine Disturbances. Ralph H. Kunstadter, Henry S. Guterman, and Alex S. Tulsky. Am. J. Dis. Child. **86:** 275–283, September 1953.

Pneumoperitoneum, with CO_2, was used by the authors as an aid in evaluating the sexual or endocrine status in a number of conditions. By revealing the presence or absence of female pelvic organs and abnormalities and other pathologic conditions, it made possible diagnosis in such conditions as ovarian agenesis, primary hypopituitarism, pituitary hypo-ovarianism, ovarian cyst, constitutional sexual precocity, and pseudohermaphroditism. Seven cases were studied and the roentgen findings in several were confirmed surgically. The details are presented in tabular form.

This procedure is particularly useful in children and adolescents because of the difficulty of bimanual pelvic examination, and it may be the means of avoiding a diagnostic laparotomy in these patients.

No hazards were encountered in the authors' series. The procedure is contraindicated (1) in the presence of an active intraperitoneal inflammatory process; (2) if there is reason to suspect the presence of bowel adherent to the parietal peritoneum at the site of puncture; (3) if the patient has any cardiac or respiratory embarrassment; (4) if systemic infection is present.

One roentgenogram; 1 photograph; 1 drawing.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE GENITOURINARY SYSTEM

Observations on Micturition in the Female. Henry Roberts. J. Obst. & Gynaec. Brit. Emp. **60:** 621–631, October 1953.

The mechanism of female micturition, normal and pathological, was studied in 220 women by cystoscopy, cystometry, and cystourethography. In addition, the urinary apparatus of cadavers was studied grossly and by serial section microscopy.

Radiological Changes in the Bladder and Urethra During Micturition. (*a*) *Before micturition:* When the patient is standing or sitting quietly with the bladder full, its base (including a small area in front of the internal urethral meatus) lies almost parallel to, and 1–2 cm. above, a line joining the lower margin of the symphysis pubis to the tip of the fifth sacral segment. The urethra joins it to form well defined anterior and posterior angles, the latter measuring approximately 100°. During strong physical effort there is a slight descent of the bladder base but the urethrovesical relationship remains normal. There is never any escape of urine into the urethra, and continence is maintained at the urethrovesical junction.

(*b*) *At the onset of micturition:* Radiologic studies at the beginning of micturition show that the bladder assumes an ovoid shape and that its posterior outline becomes crenated. Both these changes are the result of detrusor contraction, the latter representing indentations caused by the contracting fasciculi of muscle. These features persist throughout the whole time that urine is being voided.

The internal urethral meatus rotates downward and backward to bring the trigone and upper urethra into line and at the same time it assumes a funnel shape. This funneling is the result of loss of the posterior urethrovesical angle, the anterior one being preserved.

(*c*) *Micturition established:* When micturition is well established, the posterior urethrovesical angle disappears completely. The urinary stream which, in the upper urethra, is practically parallel to the plane of the pelvic brim, is directed downward in its lower course. Later in micturition the posterior urethrovesical angle becomes partially restored but the dilatation of the urethra, although diminished, remains.

If, because of modesty or other reasons, a woman fails to pass urine despite a genuine effort to do so, it is because the compressor urethrae is not relaxed. In such case, the detrusor contracts and the urethra dilates as low as the triangular ligament but no farther. The compressor urethrae can therefore successfully withstand the force exerted by the detrusor. In the same way, if a woman is asked to stop voiding before the bladder is empty, interruption of the stream takes place at the level of the compressor urethrae, detrusor contraction and dilation of the upper urethra persisting for an appreciable time after the arrest.

Urinary Physiology: Stretch receptor nerve endings are distributed throughout the bladder, but especially in the area about the trigone. These respond mostly to the rate and volume of bladder filling rather than to an increase in intravesicular pressure. Any lesion which stimulates these may cause a desire to urinate. When the detrusor muscles contract, the bladder empties. In adults this may be inhibited if evacuation is inconvenient.

Urinary symptoms are common in gynecological practice and an attempt should be made to explain them in terms of anatomical or pathological variations. The changes in uterovaginal prolapse are discussed, and the following interpretations of some of the associated urinary disturbances are offered:

Diurnal frequency in prolapse is due to a drag on the bladder base in the upright position, which stimulates the stretch receptor nerves in the bladder wall.

Urgency incontinence, or precipitate micturition, is due to an inability to inhibit the detrusor muscles. It may be due not only to prolapse but to any local irritative lesion in the bladder or urethra.

Stress incontinence occurs when the posterior urethrovesical angle is obliterated. It does not depend on the degree of prolapse, since even with severe prolapse the urethrovesical angle may be normal and the patient continent.

Incomplete Emptying: With severe cystocele the bladder may assume an hour-glass shape, with a contraction at the introitus. The dependent part may not empty well because of this or because the traction on the ureters may cause a ridge at the interureteric bar. Also, the dependent position of the bladder may form a kink at the urethral opening.

Sixteen roentgenograms exemplifying various normal and pathologic conditions; 4 photomicrographs; 19 drawings; 1 photograph; 1 graph.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Tomography as a Research Means of Bladder Walls. R. Camerini, V. Zaffagnini, and G. Lolli. Radiol. clin. **22:** 421–424, September 1953. (In English)

The authors set forth the practical possibilities of tomography with simultaneous use of endovesical and extravesical gas contrast. For details of the technic they refer to Truc, Marchal and Paleirac (J. urol., Paris **57:** 125, 1951). For pneumopelvisubperitoneum they use about 500 to 600 c.c. of oxygen. Then they slowly inject 50 to 200 c.c. of air or oxygen into the bladder. During both procedures a fluoroscopic check is made and immediately thereafter tomograms are obtained. This procedure is useful in localizing tumors of the bladder, determining the extent of their spread outside the bladder wall, and demonstrating the size and shape of the mass.

Seven roentgenograms; 1 drawing.

JULIAN O. SALIK, M.D.
Baltimore, Md.

MISCELLANEOUS

The Differential Diagnosis of Space-Occupying Processes in the Left Upper Abdomen. F. X. Bsteh and W. Zaunbauer. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 333–345, September 1953. (In German)

Palpable lesions in the left upper abdomen may be intraperitoneal or retroperitoneal. Most helpful in the differential diagnosis is the x-ray examination of the colon and of the kidneys.

Of *intraperitoneal processes*, the largest group is attributable to lesions of the spleen. The spleen is in most cases secondarily affected; only rarely is it the seat of primary disease. Of the 60 cases of splenic enlargement included in the authors' series, the diagnosis was made in 48 by hematologic examination and verified by operation. In the other 12 cases the blood picture was negative. If enlargement of the spleen is the most striking sign, the diagnosis can often be made by palpation of the characteristic crenated margin. Very characteristic is displacement of the colon. The classical sign is a downward displacement of the splenic flexure and perhaps a concave indentation from above. Rarely the descending colon may be displaced; if so, it is always pushed medialward. If the spleen can be palpated, some displacement of the colon is almost always present. X-ray examination of the kidney may show some compression of its hollow structures and some displacement. Splenic tumors may produce renal colic and hematuria. The authors' series included three cysts and one sarcoma of the spleen.

Tumors in the left upper abdomen not related to the spleen include myogenic and neurogenic tumors of the stomach and of the intestines and carcinoma of the tail of the pancreas. They usually produce a displacement of the stomach, but seldom of the colon.

Retroperitoneal lesions may be conveniently divided into those originating from the kidney itself, and those not pertaining to the kidney. Malformations, such as *cystic kidneys*, may cause some difficulties in the differential diagnosis. It may be helpful to remember that cystic kidneys are mostly bilateral and that there is often an elongation of the calyces and sometimes a cup-shaped deformity of their ends. Hematuria may occur

in cystic kidney, as well as in hypernephroma. *Paranephritic abscesses* are mostly associated with septic fever, swelling in the lumbar region, and severe pain. Important is the fact that the margin of the psoas muscle is almost never seen on the plain x-ray film. The retrograde pyelogram may show compression or defects in the kidney pelvis and in the calyces which closely resemble a tumor. *Hydronephrosis* may be difficult to differentiate from renal tumors. Of the latter, the most common is the *hypernephroma*. It usually, but not always, produces hematuria. Often a defect or some distortion of the kidney pelvis or the calyces can be demonstrated. The differential diagnosis between hypernephroma and tumor of the spleen is best made by a barium enema examination. A hypernephroma may displace the descending colon lateralward, or it may push it forward, as seen on the lateral view, but it does not produce the downward displacement of the hepatic flexure or the curved indentation from above which is so characteristic in splenic tumors. Also, the plain film may show the outline of the enlarged kidney and make the diagnosis possible. Additional information might perhaps be obtained by pneumoperitoneum and by retroperitoneal air insufflation, though the authors have not made much use of these procedures.

Among lesions not related to the kidney that may produce a palpable tumor in the left upper abdomen, aneurysms of the abdominal aorta and retroperitoneal tumors have to be considered. In two cases of aneurysms in the authors' series, there was no displacement of the colon, but there was an anterior displacement of the ureter and a tilting of the kidney. Arteriography probably would have made the diagnosis possible. Retroperitoneal tumors include cysts and sarcomata. A neurinoma of the sympathetic trunk may produce a palpable tumor, but is usually already recognizable on the plain film by its displacement of the psoas muscle.

When a retroperitoneal tumor is suspected, it may be advisable to approach it by an oblique lumbar incision. If no tumor is found retroperitoneally, the incision can be extended medially for a laparotomy.

Nine roentgenograms; 1 table.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

Observations on Neoplastic Spread: Some Radiologic Aspects of the Problem. John W. Turner. New England J. Med. **249**: 507–514, Sept. 24, 1953.

The author presents some of his observations, experiences, and conclusions after fifteen years of following a standardized method of searching for metastatic foci. He urges the abandonment of the thought that certain cancers are not expected to spread to lungs or bones. Instead, there should be periodic radiographic surveys of the lungs and the red bone-marrow areas in all patients with primary cancers that have a high metastatic index. In addition, in any cancer patient there should be x-ray investigation of atypical symptoms referable to lungs, skeleton, central nervous system, gastrointestinal or urinary tract.

The most consistent pattern of bone metastasis is that to neighboring portions of the skeleton from cancer of the prostate. Epidermoid cancer, if metastatic to bone, almost always produces osteolytic lesions. Collapse of a vertebral body due to metastatic cancer is usually asymmetrical, while collapse due to osteoporosis is likely to be symmetrical.

Myelography, angiography, urography, and gastrointestinal studies should be used more frequently for evaluation of possible soft-tissue metastatic foci in the corresponding areas.

As a criterion for surgical therapy of solitary metastatic nodules, the author suggests that the primary lesion should be a well differentiated tumor which has been controlled for one year or more. For localized metastatic disease not amenable to surgery, intensive radiotherapy is recommended.

Two tables.

JOHN J. CRAVEN, M.D.
Cleveland Clinic

Metastasis from Mammary Carcinoma to the Supraclavicular and Internal Mammary Lymph Nodes. J. J. McDonald, C. D. Haagensen, and A. P. Stout. Surgery **34**: 521–540, September 1953.

The principal lymphatic drainage of the breast is through the axillary nodes. The main collecting trunks run upward along the lateral aspect of the breast to reach the scapular and central groups of axillary lymph nodes. From here, trunk lymphatics run to the subclavicular group. Two other groups of lymphatics from the upper portion of the breast, the interpectoral group and the transpectoral group, go directly to the subclavicular group. From the subclavicular nodes one or two trunks pass beneath the clavicle to reach the grand central lymphatic terminus at the confluence of the internal jugular and subclavian veins, where entry into the venous stream occurs. Just before these trunk lymphatics from the axilla empty into the blood stream they often pass through a final sentinel cervical lymph node at the confluence. Experience has shown that when metastases have arrived at the subclavicular nodes, the disease has reached the closely adjacent grand central lymphatic terminus and has entered the venous stream or lodged in the sentinel supraclavicular node. When other supraclavicular nodes are involved, the process is usually a retrograde one from the sentinel node.

Metastases can also reach the supraclavicular nodes from the internal mammary route on each side of the base of the neck. The internal mammary lymphatic trunk also empties into the grand central lymphatic terminus. It is thus possible to have metastatic involvement of the supraclavicular lymph nodes without axillary node involvement. This is not usually the case, however.

The collecting lymphatics of the internal mammary route drain the central and medial portions of the breast and empty into the internal mammary chain. These nodes are concentrated on the upper three interspaces between the costal cartilages.

Emboli of carcinoma cells usually go first to the axillary nodes, even when the primary tumor is situated in the central or inner one-half of the breast. As the disease grows in the axillary node filters, choking them and impeding the flow of lymph through this route, there is an increasing tendency for deviation of the lymphatic flow carrying emboli of cancer cells toward the internal mammary route. This tendency is greater when the primary tumor is situated in the central and medial portions of the breast. The node in the second intercostal space is most often invaded. When the internal mammary chain is blocked, the disease extends along its collecting trunk, either cephalad or caudad or both. If caudad, the disease soon reaches the liver. If cephalad, it extends to the grand central

lymphatic terminus and, when this is blocked, spread occurs by retrograde permeation into the supraclavicular nodes.

Since involvement of the supraclavicular or the internal mammary nodes indicates widespread disease, beyond the scope of radical surgery, the authors perform a triple biopsy, which includes the primary breast tumor, the internal mammary nodes in the upper three intercostal spaces, and a supraclavicular dissection. Triple biopsy is indicated on all patients in whom there is clinical evidence of axillary metastases, for tumors of the inner half of the breast, and in all cases in which the extent of the local disease in the breast makes operability doubtful.

The authors consider block dissection of the internal mammary lymph node chain unjustifiable unless preliminary biopsy of the supraclavicular nodes has shown them not to be involved, and unless it has been proved by biopsy of the internal mammary region in the first interspace that the disease has not reached this vital point. When metastases are found in the first interspace, hope of cure by surgery is gone.

The use of supraclavicular and internal mammary lymph node biopsy has increased the exactitude of criteria of operability for carcinoma of the breast and has prevented much futile surgery. The authors' present criteria are listed.

Three photomicrographs; 5 drawings; 4 tables.

T. E. KEATS, M.D.
University of California

Relaxation of the Diaphragm Due to Disease of the Cervical Spine. C. J. Grzan. Fortschr. a. d. Geb. d. Röntgenstrahlen **79:** 369–382, September 1953. (In German)

The question of the etiology of diaphragmatic relaxation (recognizable as an elevation of the diaphragm on the x-ray film) is a controversial one. While admitting that a great variety of causes may be responsible, such as inflammatory changes, pressure upon the phrenic nerve by tumor, aneurysm, goiter, hilar nodes, mediastinal scars, etc., the author believes that the majority of cases are due to compression of the roots of the phrenic nerve in the cervical spine.

Relaxation of the diaphragm can best be observed during fluoroscopy, particularly in deep inspiration. This method of examination reveals not only complete elevation of the diaphragm, but also many cases of partial relaxation that escape observation on the routine chest film. By turning the patient in various directions, circumscribed bulging of the diaphragm can be seen anteriorly, laterally, or posteriorly.

The author has systematically studied the diaphragm on fluoroscopy and in all cases in which a partial or complete relaxation was observed has performed a routine x-ray examination of the cervical spine. In a majority of these cases, definite evidences of pressure upon the intervertebral nerve roots were demonstrated on the oblique x-ray films. These show for the most part a bony encroachment upon the intervertebral foramen.

A survey of 38 cases shows that relaxation of the diaphragm increases in frequency with advancing age, the greatest number of patients being between the ages of fifty and sixty. The right and left sides are about equally affected, but on the right side discovery of the condition is more difficult because the liver will not permit much elevation.

Osteoarthritic changes in the cervical spine are the predominant cause of diaphragmatic relaxation. The associated lipping and encroachment upon the intervertebral foramen were found to correspond in general to the anatomical distribution of the roots of the phrenic nerve supplying the section of the diaphragm involved. If the lipping was in the lower intervertebral foramina, the lumbar section of the diaphragm was chiefly involved, while lipping in the upper intervertebral foramina was reflected in involvement of the anterior or lateral portion. Since the origin of the phrenic nerve is rather variable, however, a definite relationship could not be established. Other clinical signs of nerve root involvement in the cervical spine were present in the majority of the cases, such as pain in the area of the brachial plexus, pain in the occipital region of the head, disturbances of sensibility, pain on movement of the neck, and atrophy of other muscle groups outside of the diaphragm.

Ten roentgenograms; 1 photograph.

WILLIAM A. MARSHALL, M.D.
Chicago, Ill.

RADIOTHERAPY

X-ray Treatment of Malignant Exophthalmos: A Report on 28 Patients. William H. Beierwaltes. J. Clin. Endocrinol. & Metab. **13:** 1090–1100, September 1953.

Twenty-eight patients with malignant exophthalmos were treated by irradiation directed to the pituitary. In the majority, approximately 1,500 r were delivered to each of two temporal fields during a ten-day period. (For the technic, see J. Clin. Endocrinol. **11:** 512, 1951. Abst. in Radiology **58:** 471, 1952.) Generally, patients were selected for x-ray therapy because loss of vision was imminent. Following therapy, exophthalmometer measurements were obtained at three-month intervals, using the same baseline in consecutive measurements in given cases.

Thirteen of the 28 patients treated showed a significant favorable response as measured by the exophthalmometer plus disappearance of corneal ulceration and decrease in ocular edema. Most of this group began to show measurable improvement three months after the irradiation. In 2 cases, however, no response was observed until twenty and twenty-four months after therapy. The maximum degree of recession was reached in an average of nineteen months.

The majority of the patients in whom recession occurred had had apparent exophthalmos for less than one year. Only 3 patients with exophthalmos of more than two years duration responded. Three of the 15 who did not respond had had apparent exophthalmos for one year or less prior to irradiation.

In attempting to correlate the response to irradiation with the status of the thyroid at the time of therapy, the author found that in patients with coexistent thyrotoxicosis exophthalmos was more resistant to treatment than in patients without active thyrotoxicosis. All of the group who failed to respond had a history of thyrotoxicosis. Four patients in the responsive group exhibited no evidence of thyroid disease. An attempt was also made to determine whether the administration of desiccated thyroid influenced the

response of the exophthalmos to the irradiation. No differences were found between a group of patients receiving thyroid and a group not so treated.

Five charts; 2 tables. DEAN W. GEHEBER, M.D.
Baton Rouge, La.

Cancer of the Larynx. Thirty-year Survey at New Haven Hospital. John A. Kirchner and Jocelyn C. Malkin. Arch. Otolaryng. **58:** 19–30, July 1953.

The authors review 235 proved cases of cancer of the larynx seen at the New Haven Hospital during the thirty-year period, 1921–1951, 217 in males and 18 in females. Hoarseness was the most common symptom, occurring in 81 per cent of the cases; the next most common, cough, was present in 43 per cent.

In 14 per cent of the patients who eventually proved to have cancer of the larynx the first biopsy was negative. In 9 of this group three or more biopsies were required before tissue diagnosis could be made. Ninety-five per cent of the tumors were epidermoid carcinomas. At the time of diagnosis, 4 patients had pulmonary metastases. One hundred and nine had palpable cervical, submental or supraclavicular nodes, which on biopsy proved positive in 35 instances.

In the order of frequency, the specific sites of involvement were one or both cords, the ventricular bands, the epiglottis, one or both arytenoids, one or both piriform sinuses, the subglottic space, and one or both aryepiglottic folds. The sites of involvement in those patients surviving five years or longer were, in order of frequency: cords, ventricular bands, subglottic space, epiglottis, arytenoid, ventricle, piriform sinus and aryepiglottic folds. In this connection it is stated that in the five-year survival group 83 per cent had lesions involving one or both cords. Thirty-one per cent had lesions of the ventricular band, and 23 per cent had extension to the subglottic space.

For 70 cases treated surgically, the overall five-year survival was 51 per cent. Seventy-one cases were treated by radiation alone, with a five-year survival of 22 per cent. The exact mode of irradiation is not divulged, but the calculated tumor dose was estimated to range between 3,000 and 7,000 r. The authors do indicate, however, that radiation therapy in their institution has usually been reserved for patients with extensive "non-surgical lesions" or for patients with associated organic disease which made them poor candidates for surgery. Thus, the above stated five-year survival rates of surgery and radiation therapy are not comparable.

Three charts; 7 tables.
RICHARD E. OTTOMAN, M.D.
Los Angeles, Calif.

Treatment of Cancer of the Breast. Alfonso C. Frangella. Radiología (Buenos Aires) **12:** 69–80, June 1951. (In Spanish)

The author, who has also written a large and widely circulated treatise on radiotherapy, presents a comprehensive discussion of the subject of mammary cancer and its treatment. A summary of the most imposing statistics of the last twenty years shows an average five-year survival of 65 per cent for Grade 1 and 25 per cent for Grade 2 cases, classified on a histologic basis, as the result of surgery alone. The facts brought out by radiobiologic studies indicate that ionizing radiation has a definitely destructive action on undifferentiated cells, and no effect, or even aggravation, on tumors with differentiated cells. The author is convinced that surgery alone is satisfactory only for the histologic Grade 1 cases, but even here in the hands of the most skilled surgeons the percentage of survivals is only 65. The addition of irradiation in these cases does not help, and the author has for twenty years resisted the temptation to administer preoperative or postoperative radiotherapy in this group. Within the last three years, however, he has been irradiating those Grade 1 cases shown microscopically to be highly malignant, seeking to save the 35 per cent where surgery is insufficient. He does not give "prophylactic irradiation"—in which he does not believe—but treats the patient in the most efficient manner conceivable. If there has been a preoperative diagnosis, a course of irradiation is given, concentrated into a ten-day period, two weeks prior to surgery. Otherwise, the operation is followed by intensive irradiation in the usual manner. With such treatment, the percentage of five-year survivals is increased in Grade 1 cases to from 71 to 89 per cent, according to various authors, and in Grade 2 cases to an average of 41 per cent.

The author comments on the discrepancies exhibited by various figures as to comparative results with surgery alone and with combined surgery and irradiation. He concludes that the latter procedure is indubitably better and that statistics leading to other deductions are based on cases inadequately treated or with microscopically differentiated cells, which should not have received treatment with radiation in any event. This was emphasized by Coutard, who in his last work, published in 1949, stated that when a patient with cancer is submitted to irradiation of high ionizing power and from the very first seances shows exacerbations of pain, edema (transient or permanent), vasoconstriction verified by capillary blood estimations, etc., one may be sure that the rays are not helpful and they may even aggravate the condition.

The author concludes that cases of clinical Grade 1 are best treated by radical surgery alone. Cases anatomicopathologically of Grade 2 (no axillary invasion but a mammary tumor which should be responsive to ionizing radiations) should be given postoperative axillary and pectoral irradiation. In young women (below thirty-five), if the diagnosis can be made by puncture biopsy, preoperative irradiation of the axillary and breast region, radical operation, and possible postoperative therapy are indicated. In clinical Grade 2 cases, the Halsted operation should be done, with irradiation twenty to thirty days later unless the diagnosis has been made by puncture biopsy beforehand, in which event preoperative and possibly some postoperative irradiation is indicated. Grade 3 cases should have preoperative irradiation of the axilla, breast, and supraclavicular regions, followed by simple mastectomy. The author tends to what he calls "adjusted radiant treatment," including contact therapy, for some cases of Grade 4. JAMES T. CASE, M D.
Santa Barbara, Calif.

The Role of Roentgen Therapy in Carcinoma of the Breast. D. Garth Edmunds. Rocky Mountain M. J. **50:** 666–670, August 1953.

X-ray therapy is capable of killing malignant cells and of delaying the growth of those cells which it cannot completely destroy. Surgery is capable of curing breast cancer which is limited to the breast tissues with

no distant metastases or axillary metastases, and is therefore recommended for Grade I carcinomas. In such cases, however, routine examination of axillary tissue removed at operation should be done, as some cases clinically regarded as Grade I may be found to have microscopic axillary metastases. These and all other Grade II carcinomas of the breast should have postoperative x-ray treatment. Careless and incomplete surgery accomplishes little, while the combination of expert surgery with careless and incomplete roentgen therapy accomplishes little more than surgery alone. The x-ray therapy must be given immediately and should not be withheld until evidence of recurrence or spread appears.

The criteria of incurability (Portmann) should be adhered to in determining cases which should be given x-ray therapy alone and no surgery.

Local skin recurrences are best treated by irradiation.

Although distant metastases can be treated by x-ray therapy or hormone therapy, irradiation alone or in combination with hormones is preferable. Numerous secondary effects of the hormones are objectionable.

Routine sterilization of all premenopausal women who have cancer of the breast is advocated.

D. DEF. BAUER, M.D.
Coos Bay, Ore.

Methods and Results of Radiotherapy of Breast Combined with Surgery. Gustavo Peter. Rev. mex. de radiol. **7**: 113–118, March–April 1953. (In Spanish)

The author compares the 53 per cent five-year cure rate for breast carcinoma of Groups I and II (Steinthal) at the Radiumhemmet, Stockholm, with his own five-year cure rate of 51 per cent obtained with a modified Anschütz technic in Groups I, II, and III (Steinthal). He irradiated preoperatively and, following radical surgery, used protracted roentgen therapy for a period of two years, with intervals of two to three months.

Intensive therapy is tolerated less well at such high altitudes as Mexico City, and a protracted form of therapy therefore becomes necessary.

E. KRAFT, M.D.
Newington, Conn.

Therapy of Cervical Cancer Outside of Large Medical Centers. Julius Ries and Hans Schlögl. Strahlentherapie **92**: 61–66, 1953. (In German)

The authors attempt to compare the results of treatment of cancer of the cervix in a large institution and in small hospitals or private practice. Two hundred and forty-nine patients who had been treated elsewhere for cervical cancer were referred to the Roentgen Institute of the Department of Obstetrics and Gynecology of the University of Munich between 1934 and 1946. All of these cases were of Stages I and II. Abdominal hysterectomy had been performed in 198, vaginal hysterectomy in 27, the Wertheim operation in 21, supravaginal hysterectomy in 27, and the Schauta operation in 1 case. Postoperative irradiation had been given in all patients, either a combination of roentgen and radium therapy or roentgen therapy alone. Of the referred patients, 4.85 per cent had primary fistulas and 2.4 per cent showed evidence of various radiation injuries.

Of the 249 patients treated in small hospitals and communities, 103, or 41.4 per cent, were alive after five years without evidence of disease. The five-year results of a series of similar cases treated at the University of Munich (1,895 patients) was 56 per cent.

It is concluded that, at least in complicated cases of cancer of the cervix, patients should be treated in large medical centers where competent surgeons and radiologists are available.

EUGENE F. LUTTERBECK, M.D.
Urbana, Ill.

Vaginal Recurrences in Carcinoma of the Body of the Uterus and Their Prevention by Radium Therapy. M. Willmott Dobbie. J. Obst. & Gynaec. Brit. Emp. **60**: 702–705, October 1953.

Vaginal vault recurrences are rather common when carcinoma of the body of the uterus is treated by hysterectomy alone, but not when radium therapy is used instead of surgery. The author therefore treats the entire vagina with radium three to four weeks after hysterectomy.

The present paper reports a follow-up study of 228 cases of adenocarcinoma of the uterine fundus. Vaginal recurrences developed in 7 (11 per cent) of 64 patients treated by hysterectomy alone, in 8 (10 per cent) of 80 patients receiving postoperative roentgen irradiation, and in only 2 (2.4 per cent) of 84 in whom hysterectomy was followed by vaginal radium application. In neither of these 2 latter cases was the recurrence in a treated area.

Radium is applied three or four weeks after operation, and the entire vagina is irradiated. At present a cylindrical plastic applicator is used. This is made up of components 2.5 cm. long, which can be screwed together for any desired length. Each component contains a radium source. The size is chosen to fit the vagina comfortably, and the applicator is kept in place by suturing the vagina. The usual size is 2.5 × 7.5 cm. A safe loading for a cylinder of these dimensions is 15, 5, and 10 mg. radium from above downward, used for one hundred hours. This gives a surface dose of approximately 5,000 r.

The frequently long latent period—four years or more in 17 of the recurrences in the present series—indicates the need for frequent and continued examinations. This is especially significant since 5 patients were well five years after the treatment of recurrent lesions.

The author does not compare his results with those in patients treated by preoperative intrauterine radium applications nor does he state whether vaginal radium therapy should be given to such patients.

One photograph; isodose curves; 2 tables.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Cancer of the Vulva. K. Weghaupt. Strahlentherapie **92**: 147–155, 1953. (In German)

The Lainz City Hospital of Vienna admitted 211 patients with cancer of the vulva from 1937 to 1947, of whom 186 had primary lesions. In 42 per cent of the cases the condition was associated with kraurosis of the vulva, and from the history it was noted that in 58 per cent of the women menstruation had started relatively late in life.

Treatment consisted of surgery followed by irradiation. The primary tumor was widely electrocoagulated, and the regional lymph nodes were surgically removed only if they were palpable. The primary surgical mortality was 5.2 per cent.

For postoperative irradiation a 3,000 mg. RaEl source was used at a distance of 6 cm. for an average dose,

fractionated, of 12,000 gamma r in air to the primary site. Deep roentgen irradiation was given to the inguinal areas.

The five year results were as follows:

Stage	No. of Cases	Living 5 Years or Longer Without Disease
I	70	49 (70%)
II	84	12 (14%)
III	32	1 (3%)
Total	186	62 (33.3%)

Four tables. EUGENE F. LUTTERBECK, M.D.
Urbana, Ill.

Report of Experience with Thirty Polymorphous-Cell Sarcomas of the Soft Tissues of the Extremities. Martin Goes. Strahlentherapie **91:** 537–543, 1953. (In German)

This is a report on 30 polymorphous-cell sarcomas of the soft tissues of the extremities seen at the University of Frankfurt am Main from 1926 to 1950. These cases represent 8 per cent of all sarcomas observed during that period. There were 16 male and 14 female patients. The youngest was seven years old, the oldest seventy-eight.

Six patients received radiation therapy alone and died within two years. In 24 cases treatment was by surgery followed by irradiation. Nine patients thus treated were alive after five years and 7 after ten years. These results are practically the same as for round-cell sarcoma.

The author concludes from clinical experience that polymorphous-cell sarcoma should be irradiated with a minimum tumor dose of 4,500 r, though 3,000 to 3,500 r seems to be sufficient for the round-cell type. Polymorphous-cell sarcomas containing giant cells have a more favorable prognosis.

Three tables. EUGENE F. LUTTERBECK, M.D.
Urbana, Ill.

Roentgen Therapy of the Lymphoblastomas: Lymphosarcoma, Hodgkin's Disease, Leukemias. Pedro A. Maissa and Manuel Lesende. Rev. mex. de radiol. **7:** 75–81, January-February 1953. (In Spanish)

This is a statistical review of a series of 155 cases: 74 of Hodgkin's disease, 29 of lymphosarcoma, and 52 of leukemia.

There were 8 cases of *Hodgkin's disease* with solitary foci and 66 with multiple foci. Patients in the age group forty to fifty predominated. Fifty-one were males. Only 6 survived more than eight years. Treatment of the lymph nodes was begun with 150 r, increased to 200 r, every other day, for a total dose of 2,500 to 3,000 r. With irradiation of the spleen, the best results were obtained with doses of 300 to 450 r in a series of three applications in ten days. For generalized disease, total-body irradiation was employed.

In *lymphosarcoma*, as in Hodgkin's disease, patients in the fifth decade were predominantly involved and males were in the great majority. Thirteen had solitary and 16 multiple lesions. The survival period averaged about two years. Treatment was initiated with small doses (75 r), progressively increased to 250 r, with a total dose of 4,000 r in four to six weeks.

There were 24 cases of *lymphatic* and 28 of *myelogenous leukemia*. For lymphatic leukemia the sex distribution was about equal, without predominance of any age group. The duration of the disease was quite variable—as much as eight years in one case. Myelogenous leukemia was found mostly in patients of forty to sixty years. In this series there was one ten-year survival. Doses of 500 to 700 r—in fractions of 100 to 200 r, with intervals of two days—caused regression of enlarged lymph nodes, and irradiation of the spleen with 80 r, in a series of three treatments with intervals of three or four days, was at times sufficient to bring the leukocyte count to a normal level. Such a series may be repeated after six weeks if necessary.

Six tables. E. KRAFT, M.D.
Newington, Conn.

Clinical Features and Medical Therapy of the Lymphomas, with Special Consideration of Hodgkin's Disease. H. E. Bock. Strahlentherapie **91:** 46–64, 1953.

This is one of the main papers presented during a symposium on therapy of leukemias and lymphomas at the 1952 meeting of the German Roentgen Society in Wiesbaden. Like the other papers presented at this meeting, it stresses the fact that the chemotherapy of the lymphomas with cytostatic drugs like TEM has supportive value only and is contraindicated as the primary treatment of localized lesions. ACTH and cortisone are valuable to arrest temporarily a rapid downhill course in lymphomas, and to gain time for more definite therapy.

Four illustrations. ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

Radiation Therapy of the Reticuloses, with Special Consideration of Lymphogranulomatosis. R. Bauer. Strahlentherapie **91:** 65–80, 1953. (In German)

With small doses of x-ray therapy, local recurrences of Hodgkin's disease are more frequent than with larger doses. Tumor doses of 1,500 to 4,000 r are recommended. Chemotherapy alone or in combination with irradiation gave less favorable results than x-ray therapy alone. The following figures from the author's clinic in Tübingen show the average duration of life after institution of therapy:

(*a*) 1936–1939: 37 patients treated by x-ray therapy with "medium doses": 23.1 months.

(*b*) 1940–1947: 55 patients treated by x-ray therapy with "high doses": 46.2 months.

(*c*) 1947–1951: 25 patients treated by x-ray therapy combined with chemotherapy: 15.1 months.

Nine roentgenograms; 2 tables.
ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

Roentgen Therapy of Lymphoblastomas. Study of 185 Cases. Guillermo Montaño and Mauricio Garcia Sainz. Rev. mex. de radiol. **7:** 93–102, January-February 1953. (In Spanish)

The authors' material consists of 114 cases of Hodgkin's disease and 71 cases of lymphosarcoma. The radiotherapeutic results were more favorable in Hodgkin's disease, with 21 per cent five-year survivals and 8 per cent ten-year survivals. In the lymphosarcoma series they had only 15 per cent five-year survivals (no statistical information was available for ten-year results).

It is concluded that radiotherapy has greatly improved the survival rate in both diseases, tripling it in comparison with a series of untreated cases.

Four tables; 4 drawings. E. KRAFT, M.D.
Newington, Conn.

Sub-Teleradiotherapy in Hodgkin's Disease. C. E. Garciga. Rev. mex. de radiol. **7:** 83–92, January-February 1953. (In Spanish)

By subteleradiotherapy the author means partial body irradiation in contrast to the well known total-body irradiation. He uses the following factors: 250 kv.p., h.v.l. 2 mm. Cu, focal skin distance 80 to 100 cm. Treatment is given through an anterior or posterior field, sometimes alternating the two, the remainder of the body being shielded with heavy lead. Twenty-six cases were treated by this technic.

The author emphasizes the efficiency of small doses with partial body irradiation, as compared to the larger doses needed for ordinary local treatments. The new method is recommended for extensive localized disease and advanced disseminated lesions. It is to be chosen, however, only when the development of the disease justifies its application.

The effect of subteleradiotherapy as used by the author cannot be accurately evaluated since all his patients had previously had local treatment. Nevertheless, there was a five-year survival rate of 30.8 per cent in the series of 26 cases.

Six tables. E. KRAFT, M.D.
Newington, Conn.

How Much Prognostic Value Has the Histologic Appearance of Hodgkin's Disease Prior to Radiotherapy. R. Gilbert. Rev. mex. de radiol. **7:** 103–114, January-February 1953. (In French)

The pre-irradiation histologic picture of 22 cases of Hodgkin's disease has been studied by the author and compared with the clinical course. The possibility of prognostic information based on the pathologic findings is discussed following the Jackson and Parker (Hodgkin's Disease and Allied Disorders. New York, Oxford University Press, 1947) and Sahyoun and Eisenberg (Am. J. Roentgenol. **61:** 369, 1949. Abst. in Radiology **54:** 308, 1950) classifications.

In the author's series there are 6 cases with rapid evolution (less than two years), 11 cases with a more prolonged course (two to six years), and 5 others in which the disease lasted over fifteen years from the clinical onset.

The author is aware of the fact that the histologic appearance of a lymph node biopsy may not be the expression of the true "stage" of the disease in other organs. He [rightly] emphasizes the point that the fibrosing granuloma (Class II of Sahyoun) may represent a fibrosis either as a healing phenomenon or as a marked desmoplastic tendency of an active granulomatous process. The former is seen after x-ray therapy and is an expression of true scarring; the latter does not respond favorably to radiation.

The author believes that the various morphologic pictures of Hodgkin's granuloma have no prognostic significance but must always be evaluated together with all available clinical data.

Twelve photomicrographs. R. G. OLIVETTI, M.D.
Newington, Conn.

X-ray Therapy of Basedow's Disease and of the Hyperthyreoses. W. Lahm. Strahlentherapie **90:** 519–526, 1953. (In German)

The history of our knowledge of Basedow's disease and the hyperthyreoses, as well as our concepts of treatment and its results, are discussed in detail. The opinion, expressed by Brugsch as early as 1935 (München. med. Wchnschr. **82:** 1909, 1935) that the protean picture of these affections cannot be fully explained by endocrine disturbances but calls also for an extensive study of the particular physical and psychic predisposition of the patient, is emphasized. Operative treatment is considered the last alternative, as it only influences the endocrine formula and therefore is often unsatisfactory. Its effect on the interbrain, hypophysis, and vegetative nervous system and on the pathologically changed metabolism is minor, and frequently other forms of disease ensue.

Radiotherapy is a complex procedure. The author originally described his method of treatment in 1934 (Strahlentherapie **51:** 382, 1934. Abst. in Radiology **24:** 258, 1935). In addition to the local irradiation of the neck, the hypophysis and occasionally the spleen (in splenomegaly) and the ovaries (in polyglandular dyscrasias) are irradiated. Single doses of 150 r are applied to the thyroid in weekly intervals up to a total dose of 700 r; individual doses to the thymus are 100 r each, up to a total of 400 to 500 r. Care must be taken to protect the larynx from the x-rays. The individual thyroid doses are reduced to 100 to 120 r in the summer, when the neck is generally more exposed to sunlight and skin irritation. For irradiation of the spleen, a single dose of 200 r was the rule, but a second dose of 150 r after a two week interval was occasionally added. The ovarian dosage was 100 r (single dose), anteriorly and posteriorly, the total dosage not exceeding 300 r. X-ray doses of 150 r each were applied to the hypophysis, sometimes supplemented by a second application of 100 r. Radiotherapy must be supplemented by definite dietary and medicinal measures if satisfactory results are to be achieved. ERNST A. SCHMIDT, M.D.
Denver, Colo.

X-Ray Therapy of Simple Goiter. Heinz Saitmacher. Strahlentherapie **90:** 527–535, 1953. (In German)

After an historic survey of the goiter problem, the etiologic and pathogenetic aspects are considered. By lowering the thyroxine levels in the blood, exogenous iodine deficiency causes increased secretion of thyreotropic hormone. This process induces a compensatory increase of the thyroid parenchyma. The percentage of iodine in the thyroid decreases in hyperplastic and hyperfunctional conditions. A connection between serum iodine level and thyroid function or goiter has so far not been definitely established. Certain goiter-producing substances in plants, which were proved in animal experiments, probably play a minor part in the production of human goiter. These plant substances interfere, *via* the hypophysis, with the synthesis of thyroxine. Older investigations attribute special importance to local geological and climatic conditions. The possibility of vitamin A deficiency as a causal factor is also discussed. Constitutional inferiority of the thyroid with regard to thyroxine production is considered the most important factor.

The effect of roentgen irradiation is represented by a diminution of cell proliferation in the goiter and is therefore cytostatic. Montag has proved this in animals with

parenchymatous goiters by means of methylthiouracil. The chief indications for x-ray therapy are present in diffuse parenchymatous goiter as well as in substernal goiters and in forms which show signs of compression, in so far as they are inoperable. The results of radiotherapy in other forms of goiter are unsatisfactory. Untoward side effects consist in early x-ray reactions and myxedema.

The author rejects the opinion that radiotherapy, by the production of fibrosis and cicatrization, makes a later operation more difficult. On the other hand, increased vascularization and hyperemia complicating strumectomy may occur after irradiation due to stimulation of the pre-hypophysis. Additional x-ray treatment of the hypophysis eliminates this untoward complication.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

X-Ray Therapy of Calcareous Tendinitis. W. E. Baensch. Strahlentherapie **90**: 514–518, 1953. (In German)

The value of roentgen rays in the treatment of calcareous tendinitis is again emphasized. The treatment is so effective in new acute cases that no time should be wasted with injections or other methods. None of these achieves the high rate of cure or improvement (80 per cent) observed by the author following irradiation. The doses varied from 140 r (in early acute cases) to 200 r (in subacute or chronic cases). Irradiation was applied through three fields (anterior, posterior, and lateral) over the shoulder joint. The technical factors were: 250 kv., 10 ma., 50 cm. distance, filtration 1.0 mm. Cu and 4.0 mm. Al., h.v.l. 1.95 mm. Cu.

Two roentgenograms; 3 tables.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

The Problem of Dupuytren's Finger Contraction and Its Treatment with Radium. K. W. Finck. Strahlentherapie **90**: 608–612, 1953. (In German)

The manifestations, course, treatment possibilities, and etiology of Dupuytren's contraction of the fingers are discussed in detail. A certain predisposition is considered essential for the development of the disease.

For therapeutic purposes three stages are differentiated: (1) formation of a fascial node in the palm; (2) formation of a "cord" or "rope" in the palm, possibly with beginning flexion of the fingers; (3) considerable flexion and contraction of the affected fingers. Fifteen cases of Stage 1 were treated with radium. At intervals of four to eight weeks, 70 to 100 mg. element hours were applied in a single treatment, with 1 mm. brass filtration. With two to five such treatments, flattening of the palmar node occurred first, proceeding in all cases to complete regression. In contrast to the excellent results of radiotherapy in Stage 1, irradiation proved valueless in Stages 2 and 3. Early diagnosis and treatment are therefore of paramount importance.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Experiences with Fractionated X-Ray Epilation. Kurt Baden. Strahlentherapie **90**: 494–498, 1953. (In German)

While the author rejects roentgen epilation by means of massive single doses, he recommends irradiation by fractionated doses as less dangerous and more easily controllable. For epilation of the beard he employs 4 fields over both cheeks and the regions of the upper lip and chin (with protection of the lips proper and of the floor of the mouth).

For epilation of the scalp 5 fields are employed. Filtration of 1 mm. Al (h.v.l. 0.025 to 0.05 mm. Cu), and an intensity of 70 to 100 r per minute are used. A single dose of 150 to 200 r, measured in air, is repeated after two to four days interval, the treatment series consisting of three single doses. In cases of extensive inflammation even smaller single doses and increased fractionation may be advisable. No untoward side-effects or later complications were noted during a five-year period. A second epilation treatment series is possible after the lapse of three months if clinically indicated.

Four charts.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

Disadvantages of Uniform Doses in Radiotherapy. Origène Dufresne. Rev. mex. de radiol. **7**: 259–265, May-June 1953. (In French and Spanish)

The author discusses chiefly superficial contact therapy as applied at the Radium Institute in Montreal, over a period of twelve years, to 3,000 lesions of skin and mucosa, 1,700 benign and 1,300 malignant. The technical factors were 50 kv.p., 0.3 mm. aluminum h.v.l., distance 4 cm. for lesions up to 2.5 cm. in diameter. Dosage for benign lesions was 500 to 2,000 r, and for malignant lesions 2,000 to 6,000 r. Fractionated doses produced poor results. Single massive doses at two-month intervals were found far superior. Extreme caution and careful application are necessary so that the surrounding and overlying normal tissue remain free from permanent damage.

Although immediate results may be excellent, late damage may develop after five, ten, fifteen, or even twenty years. Therefore, careful follow-up studies for a period up to twenty years are necessary for proper evaluation of results.

The author advises against a rigid technic and recommends flexibility based on experience gained from careful follow-up studies over extended periods.

E. KRAFT, M.D.
Newington, Conn.

A Simplified Method of X-Ray Deep Therapy with Moving Tube (Rotation or Pendulum Method). W. Teschendorf. Strahlentherapie **90**: 536–545, 1953. (In German)

A new rotation x-ray apparatus is described utilizing a moving tube. The method of operation is simplified by the employment of a constant distance. The tube can be moved not only in a circle around the irradiation table but also in longitudinal direction. In this manner, parallel bands of irradiation, quadrangles, and oval figures may be projected on the skin. The irradiations are always based on the actual tumor doses. Even at high tumor doses, the skin is little affected. No telangiectasis or similar skin damage was noted.

Seven illustrations showing the apparatus and its use in practice.

ERNST A. SCHMIDT, M.D.
Denver, Colo.

RADIOISOTOPES

The Clinical Use of Radioactive Gold (Au^{198}) Seeds. Arthur G. James, Ulrich K. Henschke, and William G. Myers. Cancer **6**: 1034–1039, September 1953.

The authors have found that by placing radioactive gold wire within thin-walled non-radioactive gold tubing, radioactive seeds may be made with relative ease. The tubing and wire are cut in any desired length according to the intensity desired. The seeds may then be sterilized by any of the usual means.

The gold tubing filters out virtually all beta particles but allows more than 90 per cent of the gamma rays of the Au^{198} to pass through. The energy of the latter is 411 kv., adequate for interstitial radiation therapy but requiring less lead shielding than the gamma rays of radon. The authors use an ionization-chamber type of radiation survey meter, calibrated against radium to measure the intensity of the seed to be cut.

The Au^{198} seeds may be implanted in malignant tissue with the same type of seed applicators that are used for radon seeds, or they may be loaded into nylon tubing, which can be threaded through the malignant tissue. In the latter technic, the nylon tubing and a lead container are sterilized together, permitting their eventual close proximity to the operative field but decreasing the period of radiation exposure of personnel. The authors make the tubing sufficiently long so that the segments containing the seeds may be kept in the lead container until all guide needles have been introduced into the tumor tissue and the ends threaded with the tubing. Once this has been accomplished and the incision closed, the nylon tubing may be pulled into place, bringing the Au^{198} seeds into position within the tumor tissue. Sections of tubing with seeds are placed parallel to one another at 1 cm. intervals. The seed pattern is easily readjusted by pulling the tubing into correct position if the roentgenogram shows faulty alignment.

Five cases are briefly presented, illustrating this technic.

Five roentgenograms; 4 photographs.

RICHARD E. OTTOMAN, M.D.
Los Angeles, Calif.

Cobalt 60 Teletherapy. Some Principles and Observations. Frank Batley. J. Canad. A. Radiologists **4**: 66–69, September 1953.

The author briefly discusses some features of cobalt teletherapy observed during use of the London, Ontario, unit. The maximum dose lies 6 mm. below the skin surface, thus protecting the skin from all but mild reactions. With a dose of 9,500 r to a 7 by 7 cm. field over a six-week period only a mild erythema has resulted. This absence of skin reaction can, however, be a danger as well as an asset. The limiting factor in treatment of a given area will often be deep structures not readily observable, as the bladder and rectum in pelvic irradiation.

In palliative treatment, a reduced skin reaction allows for greater doses, with corresponding improvement in palliation. The response of nodes of metastatic melanoma was previously believed to be insufficient to warrant palliative radiation, a severe skin reaction being necessary to obtain even slight resolution. A much greater effect can now be produced, in spite of the low radiosensitivity of these nodes. In irradiating mouth lesions, the risk of bone necrosis is reduced; 50 per cent more energy is absorbed in a bone such as the mandible with 250-kv. radiation than with cobalt. With irradiation of the epigastrium, nausea, while it still occurred, was felt to be much less severe with cobalt.

Depth dose curves are presented showing the advantage of cobalt over moderate voltage radiation, particularly when small fields are used. With x-rays, scatter is considerable for large fields, and its reduction with small fields decreases the depth dose. The percentage depth dose of cobalt, however, is not helped much by the addition of scattered radiation.

Some minor disadvantages mentioned include the need for 3-cm. lead shielding to reduce the dose to certain areas—as a growing epiphysis—by 90 per cent, such masses being difficult to handle, although helpful for immobilization. The maximum field size at 100 cm. F.S.D. is 20 × 20 cm., with the relatively low output of 20 r/min. at this distance.

The author concludes with the warning that, to be used effectively, the cobalt unit needs beam direction devices, a mold room, and a physicist and his instrumentarium. Cobalt by itself is not all that is needed for a radiotherapy center; without ancillary departments, most of its advantages are lost.

Three illustrations. C. M. GREENWALD, M.D.
Cleveland Clinic

A New Principle of Therapeutic Application of Radioactive Isotopes in Closed Elastic Applicators. J. Becker and K. E. Scheer. Strahlentherapie **90**: 547–552, 1953. (In German)

A method of intracavitary application of radioactive cobalt is described. The radioactive cobalt (metallic cobalt powder) is in the form of small globules imbedded in Plexiglas shells 3 mm. in diameter. A number of these globules are suspended in an isotonic, hypertonic, or hypotonic solution in which, according to specific gravity, they either sink or float. In this way, the radioactive concentration can be regulated. The Plexiglas prevents radioactive contamination of the inactive suspension fluid. The radioactive globules in the inactive fluid are applied in special rubber balloon catheters. The method has proved of value in carcinoma of the gastrointestinal tract, the esophagus, and the urinary bladder. The position of the radiopaque cobalt globules can be demonstrated by radiography, as is shown by several illustrations. In carcinoma of the stomach, the balloon catheter is best introduced through a Witzel fistula. The cobalt globules may also be directed to certain portions of the lesions by use of a magnet.

Eight illustrations. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Radioisotope Therapy of the Leukemias and of Polycythemia. L. Heilmeyer. Strahlentherapie **91**: 81–92, 1953. (In German)

The only useful radioisotope today for the treatment of the leukemias and of polycythemia vera is radioactive phosphorus (P^{32}). For polycythemia vera this is the therapy of choice; for the leukemias, it was found of approximately the same effectiveness as x-ray therapy. The author states, however, that chemotherapy is equally effective in leukemia, and is simpler and less expensive.

Twelve charts. ULRICH K. HENSCHKE, M.D.
Columbus, Ohio

RADIATION EFFECTS

Surgical Treatment of Postirradiation Rectal Stricture and Rectovaginal Fistula. E. S. Brintnall. Arch. Surg. **67**: 346–351, September 1953.

Twelve patients with rectovaginal fistula or rectosigmoid stricture subsequent to radiation therapy of carcinoma of the cervix were treated surgically at the University Hospital in Iowa City over a two-year period. The author describes the scheme of treatment as follows: A proximal colostomy is established, usually in the transverse colon, to divert the fecal stream. The damaged segment of the rectum is resected and bowel continuity is re-established, most frequently by a low transanal rectal anastomosis. After the rectal anastomosis has healed, usually in two to three months, the colostomy is closed. No repair of the vaginal wall is attempted, since vaginal healing occurs spontaneously after the rectal anastomosis is healed.

Anterior (transabdominal) anastomosis of the rectum was possible in only two instances of rectosigmoid stricture. Healing and complete fecal continence resulted in both patients. Six patients had abdominal resection of the involved segment of the rectum with an eversion transanal-type anastomosis. All 6 recovered completely, with no recurrence of fistula and no rectal incontinence.

Abdominal-perineal "pull-through" procedures were done in 3 patients. One of these died two months after the operation from sepsis and inanition. The other 2 became well and free of fistulas but were not completely continent.

In 1 patient local excision of a small rectovaginal fistula with perineorrhaphy was done, but the fistula recurred.

The technic of low transanal rectal anastomosis is described and illustrated.

Five figures. JOHN J. CRAVEN, M.D.
Cleveland Clinic

Observations on Urinary Excretion in Connection with Roentgen Irradiation of the Skull in Children for Temporary Epilation. Wolfgang Knierer and Inge Seidl. Strahlentherapie **90**: 633–637, 1953. (In German)

On the occasion of a ringworm epidemic in a Munich kindergarten, x-ray epilation of the scalp was effected in 9 children, and the influence of the irradiation of central regions of the skull on water metabolism and urinary excretion were studied. A total dose of 375 r was applied through four fields, filtered with 0.5 mm. Al. Immediately after irradiation, for a period of two to three hours, a marked frequency of urination resulted. The quantities of urine were small; the specific gravity showed little change. Neither polyuria nor inhibition of diuresis were noted. The reported changes are believed to be due to cerebral irritation (with slight influence on the hypophysis-mid brain system) and a consecutive effect on the evacuation mechanism of the urinary bladder.

Two charts. ERNST A. SCHMIDT, M.D.
Denver, Colo.

The Occurrence of Plasma Cells After Ionizing Irradiation in Dogs. Frederick J. Wohlwill and Walter W. Jetter. Am. J. Path. **24**: 721–729, July-August 1953.

Small numbers of plasma (plasmacytoid) cells may be found in the hematopoietic organs of normal dogs. These are more numerous in the medullary cords of the lymph nodes and, particularly, in those nodes which exhibit the picture of the so-called hemolymph nodes. Without exception, the authors found the cortex of lymph nodes free of such cells.

The present study describes an investigation of the appearance of plasma cells following irradiation.

Twenty-four dogs were given high doses of irradiation (250 to 400 r). Ten received exposures from 100 to 150 r. Seventeen unirradiated dogs served as controls. A 2-million-volt Van de Graaff x-ray generator, with 12.5 mm. Cu h.v.l., was used as a source of radiation. The animals were irradiated bilaterally (whole-body irradiation to 2 dogs at a time) at a distance of 3 meters from the target to the mid-line of the animal. The average dose rate at the mid-line was about 12 r per minute. Seventeen of the 24 animals given 250 to 400 r died; all of those given 100 to 150 r survived. The surviving animals in both groups were sacrificed between the thirtieth and fortieth post-irradiation days except 1 dog in Group II which was allowed to live until six months after exposure.

After the irradiation, plasma cells were found in considerable numbers in the spleen, intestinal lymph follicles, tonsils, and bone marrow. In lymph nodes, both the cortex and medulla were the seat of deposition of these cells, although the medullary cords seemed to exhibit the proclivity to produce them. No plasma cells were present in the thymus in either untreated or irradiated dogs.

The source of the plasma cells in x-irradiated dogs seems to be reticulum cells. The authors feel unable to comment upon the function of these plasmacytoid elements.

Three photomicrographs.

Experimental Investigations in Animals on the Behavior of Some Blood Coagulation Factors After Total Irradiation With Massive Doses. H. St. Stender and O. Elbert. Strahlentherapie **90**: 625–632, 1953. (In German)

The influence of total body irradiation with 500 to 1,000 r on the factors of blood coagulation in rabbits was investigated. During the first twenty-four hours after irradiation, there is a shortening of the whole blood coagulation time and of the activation time. For this change, an increase of the factors of prothrombin acceleration is considered responsible. This increase also leads to an acceleration of the change of the AC globulin of the plasma into the fully active serum AC globulin. The prothrombin levels remain unchanged. Simultaneously a shortening of the thrombin time is observed during the first day after irradiation. Three days after irradiation a marked prolongation of the thrombin time ensues in consequence of an increase of antithrombin-like substances in the plasma. While, as a rule, the thrombin times of the animals treated with 500 r return to normal after seven days, the interference with coagulation is more pronounced in the animals subjected to 1,000 r irradiation. By means of toluidin blue or protamin sulfate solutions, the thrombin time values can be made normal or markedly shortened. The prolongation of the coagulation times after large radiation doses, however, is not due to a heparin-like antithrombin. The increase in the recalcification time

without increase in the antithrombin levels points to disturbances of a thrombokinase factor.

Four tables. ERNST A. SCHMIDT, M.D.
Denver, Colo.

Radiation Protection Comes of Age. Richard H. Chamberlain. J.A.M.A. **153**: 488–491, Oct. 3, 1953.

In view of the increasing use of ionizing radiations, the author discusses the following questions:

1. *What constitutes a radiation hazard?* International standards of maximum permissible exposure have been set at 0.3 r per week (in free air) for the whole body or gonads, and 1.5 r per week for hands and forearms. This is for energies up to 3.0 mev and appropriate equivalents have been determined for other energies. Even with these given limits, the least possible exposure should be the goal at all times.

2. *Who should be protected?* In patients ill with malignant disease, radiation treatment may be carried to a point just short of where the effects of acute radiation reaction are as dangerous to the patient's life as is his disease. In roentgen diagnosis judgment as to how much radiation may be employed is best individualized, but it should never reach the levels used in malignant disease. Even for exceptional situations diagnostic uses do not usually exceed ten to fifty times the weekly maximum permissible exposure and are not repeated without adequate indication.

There is no reason for the general population to be exposed to radiation from such unnecessary sources as shoe-fitting fluoroscopes. We all are exposed to about 5 per cent of the maximum permissible dose by cosmic radiation. The "radiation worker" is a class distinct from others and might be permitted some occasional overexposure if this were essential for some exceptional problem.

3. *How to provide radiation protection?* The Atomic Energy Commission and National Committee on Radiation Protection have ample detailed literature on protection. This can be found in the *Handbooks* of the Bureau of Standards. Certified radiologists and physicists have special training in these matters. Others who are particularly interested in the use of radiation should also be trained by special programs relative to their interest. This should include use of fluoroscopy and simple radiography.

For use of radioactive isotopes, the Atomic Energy Commission has a special form of control. Local isotope committees have been established to evaluate the education and experience of the user, reasonableness of use, dosages proposed, and the adequacy of physics consultation and instrumentation. This pattern has also been followed by the American Medical Association and American Hospital Association in setting up methods for control of radiation protection in approved hospitals. A hospital committee should consist of at least a radiologist, preferably a radiological physicist, and advantageously a hematologist or interested internist. There has been developed also a group of radiological safety consultants who have knowledge of radiation hazards and protection but have no medical training.

JOHN P. FOTOPOULOS, M.D.
University of Michigan